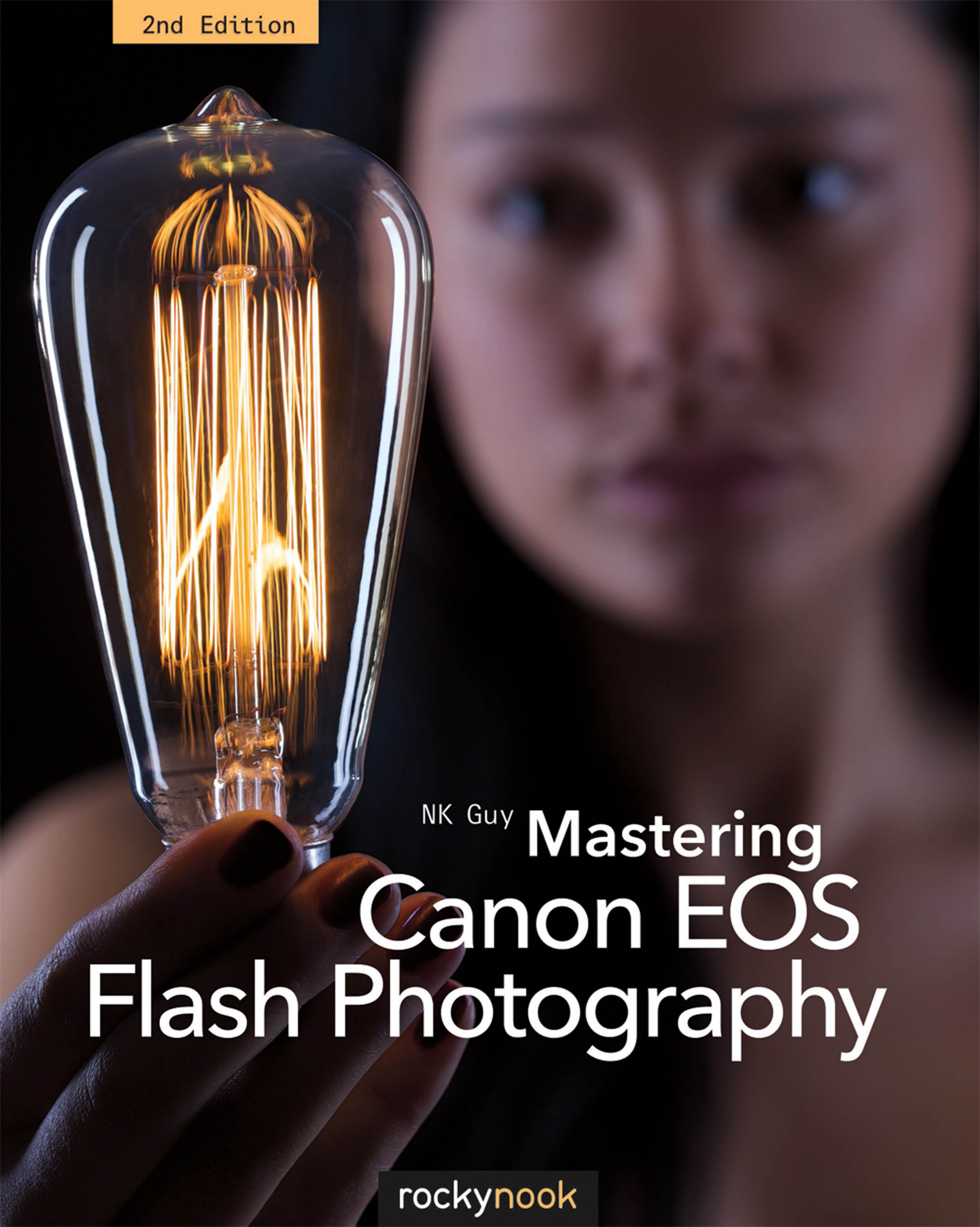

2nd Edition

NK Guy

Mastering Canon EOS Flash Photography

rockynook

NK Guy   Born in Montreal during the first snowfall of winter, NK Guy is a Canadian writer and photographer. Along with Art of Burning Man from Taschen, which is a distillation of the 65,000 photos he took at the Burning Man art festival from 1998 to 2014, he is the author of The Photographer's Dictionary (Rotovision, 2008) and The Lens (Rocky Nook, 2012). He also created photonotes.org for photographic education, and burningman.com.

There is no substance whatsoever to the scurrilous rumors that his true name is a word of ancient power, that dark forces were raised by profane and bloody ritual during the writing of this book, or that the text was in fact composed by a decaying golem who would repeatedly croak, "American spelling!" in a voice of dust and despair.

Guy lives in London, England.

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Mastering Canon EOS Flash Photography, 2nd Edition

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Important Safety Note About the Cover Photo
The cover shot was taken using a British bayonet-style light bulb. These bulbs have two electrical contacts on the base: the metal cap isn't part of the circuit and carries no current. This is how I was able to send power through the bulb (through a concealed wire, with insulated connections) while it was in the model's hand. This would not be possible, and would be very dangerous with an Edison screw-type bulb, since the threaded metal cap forms part of the electrical circuit.

For Dad. Who taught me that to find a photograph, you've sometimes got to wait.

Table of Contents

1 Introduction

Fire Spinning. A relatively long shutter time recorded the whirling loops of flame of the burning fire staff. Two flash units, a 420EX on the ground to camera left as key, and a 580EX II on-camera as fill and E-TTL master, have frozen the action. Queen Elizabeth Theatre undercroft, an area that's become an unofficial skater park. London, England. EOS 5D, 1.6 seconds at *f*/4.5, ISO 100, 30mm.

This is an example of slow shutter sync flash can be used to freeze foreground motion while exposing the background.

The invention of electronic flash and its subsequent miniaturization and automation completely transformed photography. The pioneers of photography could only shoot in sunlight, but today reliable and portable light sources are available to everyone making photography possible even in the most dimly lit settings.

Electronic flash was first used in the 1930s to freeze motion and illuminate dark scenes, but today it's used for all kinds of photography. From the creative to the mundane, from supplementing daylight to designing complex scenes with multiple light sources, there's a flash-based solution for every situation.

But flash photography can be an artistic and technical challenge. When most people hear the word "flash," they think of harshly lit snapshots: friends in a dark cavern of a restaurant or living room, staring into the lens like a deer in the headlights. This represents the typical experience of flash photography—but it doesn't have to be that way.

So the basic question is, how to go from this...

...to this?

Both photos were taken with the same camera, the same lens, the same focal length, and the same model. Everything was identical—except that the first photo was taken using the camera's built-in flash, while the second photo was taken using a two-light studio setup.

This book will help you master the use of flash, covering everything from Canon's Speedlite flash system to off-camera portable flash and professional studio lighting. It begins with the fundamentals of flash metering technology, discusses key concepts, documents the various features and functions available with EOS equipment, explores flash accessories and studio equipment, and concludes with a review of basic lighting techniques. Much of this material is relevant to users of any camera system, but most of the details of automated flash (TTL and E-TTL) are specific to Canon EOS.

Also covered is the growing field of off-camera flash, whether through portable battery units or traditional studio lighting. For years, off-camera flash was seen as too daunting for all but professional photographers, but

the combination of digital's immediacy and ease of use and popular websites such as David Hobby's Strobist.com, have brought off-camera flash to a whole new audience.

Finally, this book is intended to be as thorough as possible. Every item was tested and evaluated before being included—this is no mere advertising brochure. Products are described as honestly and fairly as possible. Unfortunately, a few popular product lines are not included because some manufacturers and distributors declined to participate.

About this book

This book is structured in three separate sections. Part I explains the technology of flash photography and how it works. Part II deals with the nitty-gritty of the equipment in finer detail. Part III offers some lighting techniques to help take great-looking photographs.

Because of the complex and interrelated nature of the topics, the book isn't necessarily structured in order of difficulty.

Why this book

In 1987 Douglas Adams wrote, "If you really want to understand something, the best way is to try and explain it to someone else." This idea was the germ of my series of PhotoNotes.org articles, which I initially wrote in 2000–2002 when I myself was struggling to understand flash technology.

In those pre-digital (for me) days, the feedback loop was quite long and expensive. I had to take photos, make copious notes, develop the film, and hope I hadn't lost the notebook by the time I got the photos back from the lab. I couldn't afford one of David Hobby's Polaroid backs. My articles began as a simple set of notes for my own use, but quickly evolved into one of the main online resources for Canon EOS flash information.

In 2008, I approached Rocky Nook about the possibility of using those articles as the starting point for a new book, and *Mastering Canon EOS Flash Photography* was born. This second edition focuses primarily on bringing things up to date and covering the latest radio wireless developments. EOS flash photography was once a sparsely documented land of mystery, but I hope these books have helped to change that.

NK Guy

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Part A: Getting Started

2 Getting Started

Poulnabrone Dolmen. A megalithic portal tomb, some 5,000 years old, in County Clare, Ireland. The photo was taken a few hours before a solstice dawn, but the orange glow of the sky is actually caused by the sodium streetlights of a distant town, and not by the rising sun. During the three-minute exposure I walked around to the other side of the dolmen and manually fired off a Canon 580EX flash unit three times at full power. This created the bluish glow and backlit the ancient stones. EOS 5D Mark II, 3 minutes at *f*/4, ISO 200, 40mm.

This is an example of manual flash triggering.

At its most basic level, flash photography just involves lighting a scene with a single, brief burst of light. It sounds simple, but flash has always been difficult to master.

This is largely because the human eye can't make out the effects of a flash burst when an image is taken—the pulse of light is too short. It's also because small light sources can produce a very unnatural form of light. So mastering flash requires two basic skills: understanding how flash will light a scene, and knowing how to modify the intense, direct light to suit your photographic needs.

Most of this book is dedicated to describing how flash works and what tools are available. But if you want to get going right away, here are some quick and easy starting points.

2.1 A beginner's configuration: Canon Digital Rebel T5/1200D with a 430EX III flash unit

2.1

The EOS Rebel T5 or 1200D (same product, different markets) is an entry-level digital SLR camera. While it contains a perfectly functional built-in popup flash unit, you can gain a lot of versatility and power by adding an external flash unit.

The Speedlite 430EX III-RT is a medium-sized flash unit that's fully compatible with all the automatic features of the camera (though since the camera is so tiny, the flash unit is a bit large by comparison!) ☐ 2.1.

Most of the information here also applies to most digital EOS cameras, to the Speedlite's radio-equipped sibling (the 430EX III-RT) and to the Speedlite's predecessors (the 430EX and 430EX II).

- To begin, install four new or freshly charged AA batteries into the flash unit. ☐ 2.2
- Slide the foot of the flash unit into the hotshoe on the top of the camera, as shown here. The base of the flash foot has a rotating lever mechanism that must be in the left-most position before attaching. The lever is then turned to the right to lock the flash unit firmly into place. ☐ 2.3
- Next, turn on the flash unit using the ON/OFF switch. After a few moments, a light marked PILOT will appear on the back of the flash unit, indicating that it's charged and ready to go. ☐ 2.4
- If you half-press the shutter button on the camera, you'll notice the ϟ symbol in the viewfinder, indicating that the camera recognizes the presence of the flash unit, and that it's charged up and ready. ☐ 2.5
- Point the camera at your subject, then press the shutter release button all the way to take a photo. The flash will fire automatically if it's fully charged.

2.2

2.3

2.4

2.5

2.2 Flash exposure compensation (FEC)

Examine your photo. Is the area lit by the flash too dark or too bright? The output level of the flash unit is determined by the camera's automatic flash metering system, but it isn't capable of making artistic decisions.

- To make the output of the flash brighter, press the button on the back of the 430EX III. It's the one directly to the right of the SEL/SET button. You can then turn the flash unit's dial to change the on-screen slider position. This is one way of applying more or less flash output, a feature known as Flash Exposure Compensation (FEC) (sections 6.17 and 9.9). Adjust to taste. In the example shown here, the flash has FEC reduced by 2/3 of a stop (rounded to 0.7) in light output. □ 2.6

2.6

2.3 Bounce flash

Direct flash is a notoriously harsh form of lighting, since most of the light illuminating the subject comes from a small and focused beam. This is very efficient but will not result in a great portrait since harsh light emphasizes the tiniest of skin imperfections.

One way to soften the light is to reflect it off a larger surface so that the light hitting the subject no longer originates from a small area. This is known as “bounce” flash, and is an easy way to improve flash photos at essentially no extra cost. All you need is a flash head that can be rotated and tilted independently of the flash unit’s body. Fortunately the 430EX III-RT has this feature.

- Let’s start with figure 2.8, which was lit by direct flash. The flash unit’s head is pointed directly at the model, and the result is a pretty unflattering shot. Every slight skin blemish is highlighted, and the slight sheen to her face reflects a bright glare. Also, since the camera was rotated 90° into portrait configuration, an ugly shadow caused by the flash is visible to the right. ☐ 2.8
- This photo was taken in a room with a white ceiling of average height, so bouncing the flash upwards was a good possibility. To adjust the 430EX III-RT’s flash head, press the release catch on the side of the flash unit that’s marked PUSH, and tilt the flash head so it points directly upwards. ☐ 2.9

2.7 Direct flash.

2.8

- Figure 2–10 is the result, and it's an improvement. The light from the flash has scattered across the surface of the ceiling and bounced back toward the model. This has eliminated the flash shadow, and the softer light is much more flattering for portraiture. There are still problems, though. Since most of the light is coming from the ceiling, her eyes and neck are somewhat shadowed, and her forehead is a little shiny. The picture is also lit in a fairly symmetrical fashion, which isn't very interesting. ◻ 2.10
- In figure 2.11 the flash is bounced off the wall. This simply involves rotating the flash head sideways and bouncing the light off the wall to camera left. Since the wall is off-white and fairly close, it provides a good lighting surface. Additionally, the wall light is reflected in her eyes, providing a lively and friendly "catchlight." Finally, although there's plenty of light reflecting off the right-hand wall, more light is coming from the left, providing some interesting shadowing to the model's face. This picture looks both softer and more three-dimensional. ◻ 2.11

2.9 Ceiling bounce flash.

2.10 Wall bounce flash.

These are three very different-looking photos, yet the only change I made was to the angle of the flash unit's head.

Obviously, bounce flash isn't always an option. It doesn't really work outdoors or in huge rooms where there's nothing nearby to serve as a reflector. It can also be a problem if the walls or ceiling are painted bright or dark colors. Fortunately, in a typical small indoor location, it's an effective and simple way to get a more flattering portrait.

2.4 Daylight fill flash

Flash seems like the sort of thing that's only really useful at night, but in fact it has its uses in bright sunshine as well. When flash isn't the primary source of light in a scene like this, it's referred to as "fill flash" since it's filling in the shadowed areas.

- Consider the first photo, which was taken in direct sunlight. Sunlight on a cloudless day casts very sharp shadows, as can be seen under the model's eyebrows and neck. ❑ 2.12
- The second photo, on the other hand, was taken with a flash as on-board fill. Note how the use of flash has certain advantages and disadvantages. ❑ 2.13

2.11

2.12

- On the positive side, the shadows are less high-contrast. Fill flash lightens shadows more than it lightens areas that are already bright. The flash also causes a bright catchlight to appear in the model's eyes.
- On the negative side, the image is now flatter and less three dimensional in appearance. In fact, if fill flash is too bright, it can give a sort of cardboard cutout look to a portrait.
- From a user's point of view, enabling fill flash is as easy as turning on the popup flash or connecting a Speedlite. Canon EOS cameras automatically apply fill flash if they detect that they're photographing scenes lit by daylight levels of light. However, if your camera is applying too much flash, it can be useful to use FEC to dial down the flash output slightly.

2.5 An advanced configuration: two wireless 430EX III-RT flash units

Modern flash technology makes it easy to control more than one flash unit simultaneously. This allows you to illuminate various areas of a scene, applying light like a painter with a brush. In the past, a degree of skill and experience was needed to combine multiple flash units, but automated wireless technology makes it much simpler.

To control flash units wirelessly using Canon's system, you need at least two devices. One is the controller (the "master" in Canon terminology) and one the remote unit (the "slave"). Historically, only top of the line Canon Speedlites could act as masters, but now the midrange 430EX III-RT used in this example can serve as either master or slave in radio mode.

Important note: this example uses two 430EX III-RT units. The RT bit matters. The 430EX III (with no RT) has no radio capabilities, and since neither version of the 430EX III can transmit commands using light (i.e., optical wireless), you can't do a setup like this with two 430EX III units. That doesn't mean you can't use other 430EX models wirelessly, but you'd need a different master unit. □ 2.14

Some of this information applies generally to all digital EOS cameras and Speedlites, but each model has some differences. Check chapter 9 for details on each Speedlite.

- Attach the 430EX III-RT you want to use as the master to the camera's hotshoe, since the master and camera need to be linked directly—only the slave communicates wirelessly. Turn on camera and flash unit.
- To enable radio wireless mode on the 430EX III-RT, press the button marked with the symbol. This horizontal zigzag symbol with two heads means "wireless master/slave flash" in Canon's symbology. Then rotate the dial until the MASTER symbol appears on the screen. □ 2.15
- Do the same for the second 430EX III-RT, but rotate the dial to choose SLAVE rather than master.
- Position the remote "slave" flash unit in an interesting location off-camera relative to the subject. The Speedlite ships with a small plastic stand that can be used to prop up the flash unit.
- Make sure the LINK light is green on both master and slave. If they're not, then it's likely that the two units are on the wrong radio channel or have different radio ID numbers set. Check sections 9.19.1 and 9.19.3 for details on changing channels and IDs. A slave unit with a red LINK light won't fire. □ 2.16
- Take a photograph. Both units should fire simultaneously, the result being a picture lit by both the on-camera Speedlite and the off-camera unit. Canon EOS cameras support multiple off-camera flash units, so complex photos can be designed with up to 15 slave units if your budget can afford it! □ 2.17

2.13

2.14

2.15

2.16

2.6 A practical example of wireless flash

For this example, we'll take another portrait in a dimly lit room. The standard on-camera direct flash photo looks, to be frank, absolutely horrible. The model's face looks kind of flattened, and the background is an empty void. This is an example of why direct flash lighting does such a disservice to humanity. ☐ 2.18

- To cut the harshness, the on-camera flash is put into bounce mode and directed toward the ceiling. The problem is that the background is still pretty dark. The solution? A second light source.
- First, the on-board 430EX III-RT is put into master mode. Then the second 430EX III-RT is placed on a light stand and positioned behind the model, camera right. Its beam is narrowed by setting the zoom to 80mm, it's put into slave group B, and it's pointed toward the curtains.


2.17


2.18


2.19

- When a photo is taken, the on-board master is bounced off the ceiling, providing softer light to the model. The richly colored maroon curtains are lit by the second flash unit, providing a more sophisticated texture. It looks like a photo of a completely different person. ☐ 2.19
- In basic wireless mode, both flash units will fire at the same output level. For more control over multiple flash output, wireless E-TTL supports a concept known as "ratios." This allows for finer control between different groups of flash units. It's also possible to prevent the on-camera master unit from lighting the scene. For more details on wireless E-TTL flash, consult sections 9.17 and 11.8.
- Wireless flash doesn't have to be expensive, especially if you use optical wireless rather than radio wireless. Many post-2009 Canon EOS cameras can control remote slaves by using the built-in flash. This makes wireless flash even more convenient and affordable.

2.7 Dragging the shutter

One of the challenges we face as photographers is conveying motion in a still image. One way to take a photo of a moving dancer or a speeding racecar is to freeze the action by using a short shutter speed. Since that can look static, another way is to use a long shutter speed to record a blurring, flowing motion.

- Here's a photo of a dancer taken at 0.4 seconds. ◻ 2.20
- Although the shot looks fine as it is, it's too blurry to make out the dancer's face. But what if flash is fired at the same time? Flash is so short in duration that it freezes motion for that one moment. By combining flash and a long exposure, we get a sort of double exposure. ◻ 2.21

2.20

2.21

- This technique is known as slow shutter sync or "dragging" the shutter. You can see how the flash has recorded the dancer's face quite well, but there are also blurring swirls of motion.
- To use this technique on a Canon EOS camera, set the camera to Av (aperture priority), Tv (shutter or time priority) or M (manual) modes. Don't use P (program) mode or most of the icon modes, as they can't drag the shutter.
- Turn on the flash as usual. In this example, the flash is actually an off-camera 430EX unit positioned camera left and triggered wirelessly.
- It may be best to use Tv mode and experiment with different shutter times to record more or less of the subject motion. This can be tricky if light levels vary, so M mode is often the most reliable way to use this technique.

- While useful for photographing wedding dances and rock concerts, dragging the shutter is a little hit-and-miss by its very nature. It often takes quite a few shots to get one that truly captures the moment perfectly.
- The keen-eyed will note that the areas of the image lit by flash are a different color than the slow, swirly areas. This is because light from a flash is fairly blue in color, and light from an ordinary tungsten light bulb, which was used to light the scene, is fairly orange. For more information on this phenomenon, known as color temperature, check out section 7.18.

2.8 Getting the flash off the camera

One of the key lessons in any book on flash photography is that it's vitally important to get the light source away from the lens. With a handful of exceptions, such as ring flash and light applications of fill flash, most subjects don't look very good when lit with on-camera flash.

Take the previous examples. While technically the bounce flash shots were lit by on-camera flash, it's important to note that the light from the flash was actually reflected off a nearby surface. Accordingly, the shots were lit from the wall, not the camera.

So, however you do it—cables from camera to flash, wireless E-TTL as described above, or high-end radio-based flash triggers—try moving the flash off camera. The results may surprise you!

2.22 Using a custom-built shallow indoor pool, designer Nelly Ben Hayoun built a stylized model of Japan's Super-Kamiokande neutrino detector. Mylar balloons represented the photomultiplier tubes used in the real detector's sensors. The installation, Super K Sonic Booooum, was in Shunt Lounge, a performance space in the now sadly demolished tunnels beneath London Bridge railway station. To illuminate the work I put a radio-triggered Speedlite 580EX into the small rowboat. All the white light in the shot originated from the bottom of the boat, and was reflected by the balloons.

2.23 This children's fairground ride was photographed with available light. Frankly, it isn't a particularly interesting shot, and too much clutter is visible.

2.24 The same shot, but this time lit with a handheld flash on a cord, positioned low and to the left of the camera. The result is more interesting—and quite a bit spookier!


GRAPHIC
GRAPHIC

3 Top Ten FAQs

Film Noir. *Crime. Tough beat, though it pays the rent, and it's the best way to hustle a paper. But tonight, there was every film noir cliché in the book, stretched out cold. Brittle and shameless, like a drunk in the park. I turned to leave, but took a shot anyway. That on-camera Speedlite 580EX II wasn't set as an optical trigger by accident.*

Speedlite 580EX II to camera left, zoomed to 105mm and triggered optically using a Sonia slave device at 1/32. A set of window blinds were hung from a light stand, out of frame, to cast the shadows to the left. The flash in the Graflex reflector is actually a small electronic flash unit from a toy camera, modified and installed inside a glass bulb. It was also triggered optically, to sync with the camera. EOS 5D Mark II, 1/200 sec at *f*/7.1, ISO 200, 100mm.

This is an example of manual flash, triggering by "dumb" optical slave devices.

1

My camera already has a built-in flash. Why should I buy an external one?

That depends on what you want to do with your photography. Popup flash units are great for simple snapshots. You can't lose them unless you lose the whole camera, they don't add weight or bulk, and no extra batteries are needed.

On the other hand, the light from a popup flash is limited in range and tends to create harsh-looking photos. External flash units always provide much more power, and thus greater lighting distances. External flashes are also more flexible lighting devices, and they can enable the creation of more attractively lit photos when using the proper techniques. For example, an external flash with a swiveling head can be used to bounce light off a nearby wall or ceiling, resulting in softer lighting than direct flash.

Admittedly, flash can't solve every photographic lighting problem. It's a valuable tool, but sometimes the best way to ruin a nice picture is to blast tons of light onto the scene with a flash unit. Available light photography forces you to slow down and consider the light around you, which can ultimately help you become a better photographer. This may sound like a surprising thing to say in a book about flash photography, but the goal of any photographer should be to use whatever tools are appropriate to get the best shot.

2

Why are the backgrounds of my flash photos pitch black? It looks like I was in a cave!

In P (Program) mode, and all flash-using icon modes except for night mode, Canon EOS cameras assume that the flash is going to be the primary light source for the foreground subject. The camera is programmed to use a brief shutter speed (short exposure time) in these conditions.

However, if the ambient light levels are low, such as at night, the background will turn out very dark. This is because the flash can't illuminate the background; additionally, the shutter speed is too short to expose adequately for those background areas.

The light from any battery-powered flash unit is always limited: you can't expect to light up the Grand Canyon or the Eiffel Tower. Only subjects in the foreground, or near to the background, such as in a small room, are going to be lit. Simply cranking up the power of an on-camera flash unit won't help bring up the background, since that will cause the near foreground to be overexposed.

To avoid the problem of black backgrounds, you will need to take the photo in Av, Tv, or M modes, as described in section 6.6, or use a second flash unit to light the background separately.

3

Why does the camera set a really slow shutter speed when I use a flash? Parts of my photos look sharp, but there's weird fringing.

This situation is the reverse of the previous question. It happens when you take a flash photo in low-light conditions and the camera is in Av (aperture priority) mode or the night icon mode.

In Av, night, and Tv (shutter speed priority) modes, the camera meters the ambient (existing) light, and then fills in the foreground subject using flash. It doesn't assume that the primary light source is the flash unit, and so the shutter speed it sets is the same as if you weren't using flash at all.

In low light, this results in very long shutter times. If the shutter speed is very long, you'll need a tripod to avoid motion blur during the exposure. If something in the photo, such as a person, moves during the shot, then you'll end up with a double exposure. The flash-illuminated person will appear sharp and crisp, but the person will also be illuminated by ambient light, leading to ghosting or fringing. This can be desirable in some cases, as it lends a sense of motion, or it can just look like a smudgy mess.

Alternatively, you can switch to full auto (green rectangle) or P (Program) modes, which automatically expose for the flash-illuminated subject and not the background. These modes try to ensure that the shutter speed is high enough to let you handhold the camera without a tripod. The drawback of P and full auto modes is described above—dark backgrounds under low light conditions.

4

Why are the eyes of my friends and family glowing an evil red?

This is the "redeye" effect, a common problem with flash photography. It's caused by white light from the flash unit reflecting off the red blood vessels lining the interior of the eye. "Greeneye" in cats and dogs is similar, though with a different underlying cause.

The easiest way to minimize photographic redeye is to use an external flash unit rather than a built-in flash, and reflect ("bounce") the light from the flash unit off a wall or ceiling. For more detail, consult section 9.8.

If, however, the evil glowing eyes are visible in real life and not just in your photos, then you should probably consider arranging an exorcism. Contact a tabloid first if you want to exploit the situation to your financial advantage.

5

Why won’t my camera let me set a high shutter speed when I turn on my flash?

Each camera model has a maximum shutter speed that can be used with flash. This is known as the flash sync or maximum X-sync speed, and it varies from 1/90 second on older low-end cameras to 1/500 sec on one pro model. If you set a high shutter speed (say, 1/2000 sec) and you turn on a built-in flash unit or a Speedlite, the camera will automatically bring your shutter speed down to the X-sync value.

The maximum shutter speed when flash is used is always lower than the maximum shutter speed of an EOS camera, for complex mechanical reasons described in section 7.10. The X-sync value can be circumvented if your camera and flash unit both support high-speed sync (section 7.12).

6

I have an old flash unit. Will it work on my new Canon EOS digital camera?

Maybe. It depends on what type of flash unit you have and how you want it to work.

Canon EOS digital cameras work automatically with Canon Speedlite flash models ending in EX. However, if your Canon flash unit has a model name that ends in E or EZ or anything else, then its automated features will *not* work with EOS digital. It will fire at full power only, or not fire at all, depending on the camera.

As for flash units manufactured by other makers, check the specifications to see there’s support for “E-TTL flash metering.” If not, or if only “Canon TTL flash metering” is listed, then the unit probably won’t work automatically with a digital body (see section 7.2.2).

Some flash units have manual output controls, which let you specify the flash unit’s power output by hand. While this sounds limiting, manual flash as described in chapter 10 is actually a great way to light a scene.

If it’s a very old flash unit (pre-1980 or so), or if it’s a large studio flash unit that runs off AC power, it’s worth confirming that its trigger voltage won’t destroy your camera (see section 10.5).

7

I took two flash photos in rapid succession. Why is the second one totally dark?

All flash units take a number of seconds to charge up between flash bursts; the cycle time. If your second photo is dark, it probably means that your flash unit hasn't had time to recharge after the first burst. You'll need to wait for the unit to charge back up (and the pilot light on the back goes on) before taking the second photo.

Some flash units have "Quick Flash" ability that lets them fire when only partially charged. If your flash can do this, then you still probably took the second photo too quickly; the flash unit didn't have enough time to recharge to an adequate power level but tried to fire anyway.

Different types of batteries charge up the flash at different speeds, so you might want to consider your battery options. To achieve a more rapid cycle time, external battery packs (section 12.12) are often used by wedding and news photographers. Note also that if your camera has a small built-in flash, it probably recharges more quickly than an external unit.

8

Why are my photos dark when I use a Speedlite EX or built-in flash to trigger my studio flash equipment?

The short answer is that manual flash metering (flash output set directly by the photographer) is not compatible with automatic flash metering (flash output controlled by the camera). You can't reliably mix and match the two when optical slave triggers are used.

The slightly longer answer is that Speedlite EX flash units, when operating in E-TTL mode, send out at least one brief flash of light before the actual scene-illuminating flash. This "preflash" will prematurely trigger the optical sensors used by most studio flash units and optical slave devices. Consequently, since the light from the studio gear will have faded by the time the shutter opens, the resulting pictures will be too dark. For more details, consult section 11.7.3.

In this shot, E-TTL prefire triggered the studio flash too soon. The camera has recorded the reddish tail end of the slave flash unit concealed inside the antique camera's flash bulb. See pages 20–21 for what this photo is supposed to look like.

9

Why use flash at all? Why not just use a fast lens and a high ISO?

As digital cameras improve and their image quality at high ISO settings becomes less noisy, this question becomes even more relevant. Why not shoot at *f*/1.8 with, say, ISO 3200? There are a number of reasons you might want to consider using flash, and a number of reasons you might want to avoid it.

Shooting at wide apertures like *f*/1.8 means that the depth of field (DOF)—the area of the image in sharp focus—will be very, very shallow, especially with a longer lens. If more than one person appears in the photo, for example, it will probably be possible to get the eyes of only one person in focus. If people are moving around, such as at a wedding, it probably won't be possible to nail accurate focus with such a shallow DOF.

Shooting with a high ISO means that the picture will be noisier. Most digital cameras have grungy speckled "noise" at high ISO settings, which can mar the appearance of the photo.

Finally, with flash you have total control over the lighting. Available lighting is great, but there are times when the ability to specify precisely what light goes where can be very valuable. In a sense, this is about building a photo rather than finding it.

10

Why do my flash photos look so lousy? Do I need to buy a better camera or a more expensive flash unit?

Camera advertising often suggests that modern, fully computerized flash has the magic ability to let even inexperienced photographers take amazing photos. However, while automated flash has taken a lot of the drudgery and guesswork out of using flash, it hasn't eliminated the need for good technique.

The first step in improving flash photography is to understand the nature of lighting. On-camera flash originating from a small light source is usually going to make hard-edged, harsh, and unflattering photos. That's what most people think of when they think of flash.

The first step is to move the flash unit off the camera or to use multiple flash units. The second step is to start experimenting with light-modifying tools such as diffusers, softboxes, umbrellas, and filters. These are ways of improving the quality of light so it's no longer just a harsh, blue-white beam emitting from the top of the camera.

While much of this book focuses on automated flash, this is often just the beginning. Most of the best flash-illuminated photos out there are taken by experienced photographers using purely manual equipment.

4 Terminology

From Below. Most of the photos in this book have minimal post-production alterations—usually just a bit of contrast or brightness work. This is, after all, a book on flash photography and not Photoshop techniques. However, this shot required considerably more work in postprocessing. It was taken on location, not in studio, with the model standing on a sheet of clear acrylic that was inside a wooden frame built for the shot. 580EX II and shoot-through umbrella, linked to the camera with an off-camera shoe cord, to light the model. However, because a 17mm wide-angle was used, the platform frame was visible around the edges. A second shot was taken with the frame out of view, and the two pictures were combined digitally. Air Street, London, England.

This is an example of automatic off-camera wired flash.

There's a lot of confusing and inconsistent terminology related to flash photography. For simplicity's sake this book uses the following conventions:

AUTOFLASH
A flash unit that measures its own light output using a self-contained sensor, not through the camera. Common in the 1970s; rare today.

AUTOMATIC/AUTOMATED FLASH
Flash technology in which the light output of the flash unit(s) is controlled by a computer inside the camera.

BUILT-IN FLASH
Synonyms: popup flash and internal flash. A flash unit that's built right into the camera body. In the case of Canon EOS cameras, an integrated flash unit that pops up from the top.

EXTERNAL FLASH
A standalone flash unit that is not built into the camera body.

FLASH
A bright pulse of light, usually produced by an electronic device, for photographic lighting.

FLASH CARD, FLASH MEMORY
A solid state (no moving parts) memory card for digital cameras.

FLASH UNIT
An electronic light-producing device used for flash photography.

MANUAL FLASH
The light output of the flash unit(s) is set directly by the photographer.

MONOLIGHT
A self-contained studio flash unit, powered by AC current.

OFF-CAMERA FLASH
A flash unit that isn't built into or fastened to the camera itself, and is usually positioned some distance away. It may be controlled by a cable, by light or infrared signals, or by radio commands.

PACK
A box serving as a power source for a studio flash unit (see Generator, p. 31).

SPEEDLITE
Canon’s trademark for its line of battery-powered flash units.

STROBOSCOPIC
Multiple bursts of light at regular time intervals, from a flash unit. A bit like a nightclub strobe light.

STUDIO FLASH UNIT
A larger flash unit designed for use in a photographic studio; usually powered by AC current.

WIRELESS FLASH
A flash unit controlled remotely without wires, and which isn’t physically connected to the camera. The command signals can be radio transmissions, pulses of light, or infrared.

The following terms aren’t used in this book because of their potential for ambiguity:

FLASHGUN
A small battery-powered flash unit.

FLASHLIGHT
A rare synonym for a flash unit, which is easily confused with a battery-powered lantern (US).

GENERATOR
(UK) A power pack for studio flash lighting (see Pack, p. 34).

MONOBLOC
(UK) A monolight.

SPEEDLIGHT
A Nikon trademark; sometimes refers generically to a small battery-powered flash unit.

STROBE
(US) Sometimes any flash unit; sometimes only an AC-powered studio flash unit.

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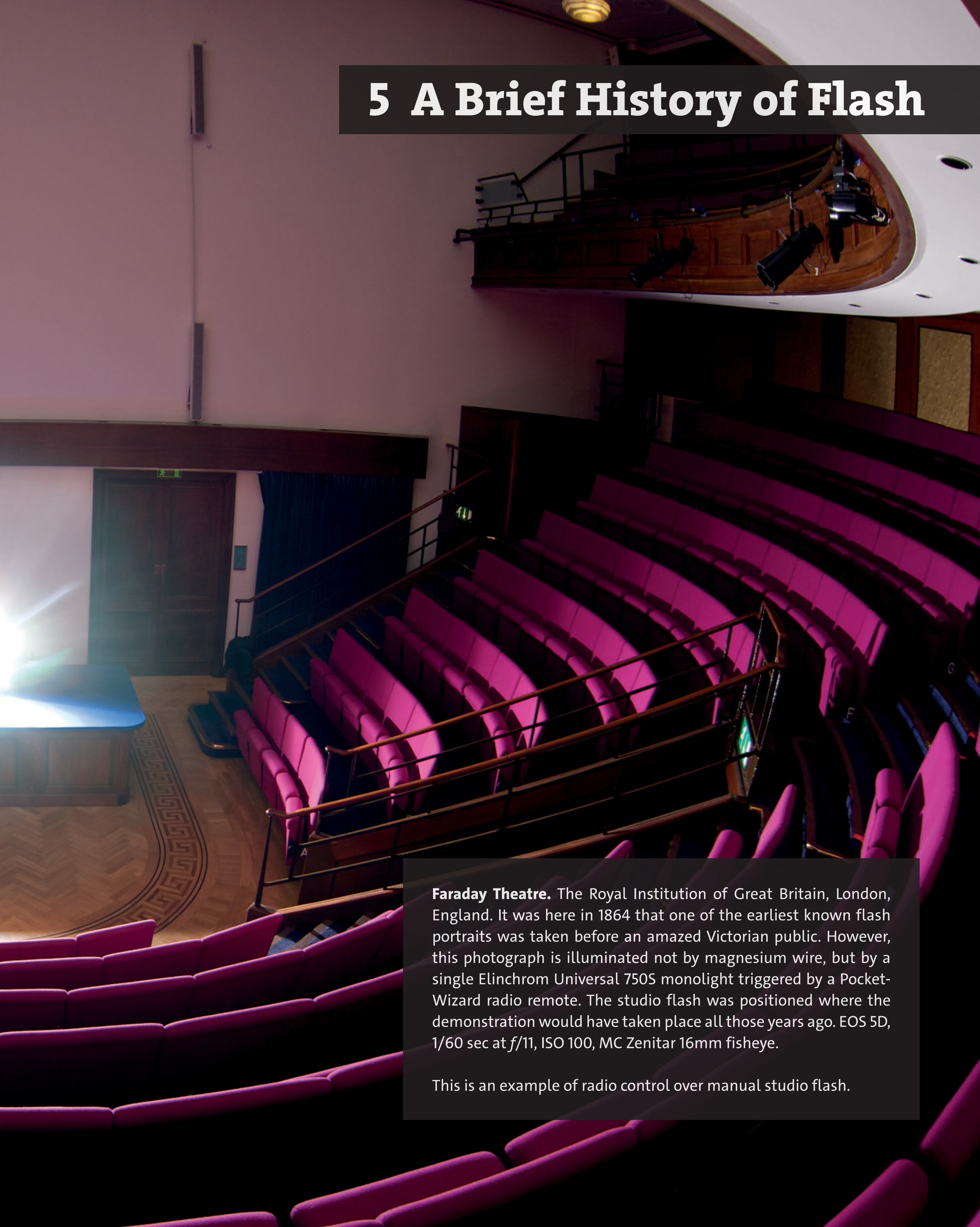
Part B: Technology

5 A Brief History of Flash



Faraday Theatre. The Royal Institution of Great Britain, London, England. It was here in 1864 that one of the earliest known flash portraits was taken before an amazed Victorian public. However, this photograph is illuminated not by magnesium wire, but by a single Elinchrom Universal 750S monolight triggered by a PocketWizard radio remote. The studio flash was positioned where the demonstration would have taken place all those years ago. EOS 5D, 1/60 sec at *f*/11, ISO 100, MC Zenitar 16mm fisheye.

This is an example of radio control over manual studio flash.

The very first photographers could only take their pictures in bright sun, since those early photographic processes reacted very slowly to light. The oldest known photograph, taken in 1826 by French pioneer Joseph Nicéphore Niépce, actually took a whole day to expose. The invention of the Daguerreotype process cut this down to minutes, but artificial light was still too weak for most photography. In fact, one of the principal requirements for a photographic studio in Victorian times was a skylight to provide adequate illumination.

Scientists and inventors labored throughout the 1800s to devise artificial photographic lighting, many intuitively understanding that a brief bright burst of light could illuminate a scene just as effectively as dimmer light used for a longer period of time: a concept that's fundamental to all flash photography. As early as 1851, Briton William Henry Fox Talbot demonstrated how electric sparks could capture freeze-frames of moving objects. By the late 1870s, studios in rainy London were proudly advertising their use of electric lighting for portrait photography. But these early light sources, including electric arcs, oxyhydrogen (limelight) lamps, and battery lamps, weren't very bright, or relied on large generators.

5.1 Michael Faraday's magnetic laboratory at the Royal Institution of Great Britain, London. It was most likely in this lab, restored in 1972 to appear as it did in the 1850s, that Fox Talbot first demonstrated photographic flash. EOS 5D, on-camera ST-E2 trigger, 580EX to camera left with 1/2 CTO filter, 580EX with 1/2 CTO filter, 420EX on floor unfiltered.

5.1 Pyrotechnics

Fox Talbot's pioneering spark experiments were frustrated by the limited power produced by the batteries of the day. The first viable form of artificial photographic illumination was the intense white light created by burning magnesium. The metal's potential was recognized before the widespread use of electric lights, and one of the first documented public demonstrations was performed by Alfred Brothers at the Royal Institution in 1864.

The following year Scottish-Italian astronomer Charles Piazzi Smyth, notorious for his bizarre theories tying the Egyptian pyramids to Biblical prophecy, burned magnesium wire to photograph the interior of the Great Pyramid of Giza. Some two decades later in Germany, Adolf Miethe and Johannes Gaedicke added an oxidizing agent to powdered magnesium, commercializing *Blitzlichtpulver,* or "powder for producing lightning-like light."

Magnesium powder became more than a flash in the pan when Jacob Riis, a Danish-born journalist living in the U.S., used it to document the poverty and privation of New York City slums. His book of photo illustrations and muckraking essays, titled *How the Other Half Lives,* shocked the American public of 1890, including a then-police commissioner by the name of Theodore Roosevelt.

The technique employed by Riis was quite dangerous. He would set up a camera in a dark or dimly lit room, pour some powdered magnesium and an oxidizer into a frying pan, open the shutter, and then ignite the powder. The result was a brilliant burst of light, startled subjects, and a billowing cloud of noxious smoke and ash. While his photos changed American views of immigrant housing, he is said to have set his clothes and surroundings on fire on a number of occasions.

5.2 From left to right: Eastman (Kodak) flash "pistol" circa 1900–1905, a device for igniting magnesium flash cartridges. The leather guard was meant to protect the photographer's hands from burns. Kodak magnesium ribbon dispenser, circa 1915–1920. The thin ribbon could be measured out in length (and thus time), and was used mainly for exposing photographic paper. Flash sheets, which had shorter burn times, were more commonly used for portraits.

Magnesium powder sold in teabag-like envelopes by Seuthelin, circa 1925. A long paper strip dangled down and was lit as a simple self-timer, like Wile E. Coyote lighting a track of gunpowder.

Magnesium was used, packaged in various forms such as cartridges and sheets, well into the 20th century. Textbooks and instruction manuals of the era speak quite matter-of-factly about techniques required to minimize the risk of accidents and fire.

5.2 Flash bulbs

A breakthrough in photographic safety was developed in Germany in 1929–30 when Johannes Ostermeier patented the first mass-market flash bulb, sold under the Sashalite (GE) and VacuBlitz (Osram) names. These foil-filled glass bulbs, when connected to a low electric current, would burst with white light and a loud pop.

Press photographers from the 1930s through the ’60s, immortalized by scenes on the courtroom steps in countless films, burned through huge quantities of disposable bulbs. They also burned their fingers, as the bulbs were quite hot after firing. A later innovation was a lacquer or plastic coating to reduce the risk of subjects being injured by flying glass if the bulb shattered. Bulbs designed for color photography had blue-tinted lacquer to improve the color balance.

5.3 A three-cell Graflex flash handle, reflector, and flash bulbs. These were used with Speed Graphic press cameras in the 1940s and ’50s.

Trivia note: a handle of this type was used as Luke Skywalker’s light saber in the original *Star Wars* movie released in 1977.

Flash bulbs eventually shrank down and became incorporated into consumer products such as the FlashCubes, MagiCubes, and FlipFlashes, which illuminated countless birthday parties and family snapshots in the ’60s and ’70s. □ 5.4

Ultimately, however, such single-use flash bulbs were an evolutionary dead end. Flash bulbs are mainly used today for historical reenactments (e.g., period movies), theatrical special effects, and special applications such as cave photography because they can produce massive amounts of light despite their small size.

5.4 Household flash photography in the 1960s and '70s looked like this. A Polaroid SX-70 instant camera from 1972, equipped with a flashbar. Next to it are a FlipFlash and an assortment of MagiCubes and FlashCubes. The photos were taken using Artistic Time Zero film manufactured during the final production run at Polaroid's last factory before it was sold to the Impossible Film Project.

5.3 Electronic flash

It was the xenon flash tube, first developed for photographic purposes in the 1930s by American researcher Harold Edgerton, which brought about the demise of the flash bulb. Edgerton's work at MIT initially focused on freezing motion for engineering research, but it soon became clear that flash tubes would be convenient for general photographic lighting as well. For years, flash tubes mainly stayed in the studio because of their hungry power demands. Early portable electronic flash systems were also heavy: a battery-powered unit built by Kodak in the early 1940s weighed 16 pounds! But by the 1960s and early 1970s, improvements in battery and capacitor technology made electronic flash affordable, convenient, and portable.

All electronic flash units (except for white LEDs used in phone cameras) have the same basic design. First, a component known as a capacitor is charged up with electricity. The accumulated energy is then sent to a glass tube filled with the inert gas xenon. The electricity causes the gas to ionize, producing a split-second electrical discharge that emits a brilliant burst of white light.

Flash tubes are ideal for photography because they can be fired many times, their outputs can be precisely controlled, they allow for brief motion-freezing exposures, and their basic design can scale from tiny pocket flash units all the way up to huge studio equipment.

But there were two fundamental technical problems that had to be solved before electronic flash could become the widespread lighting solution that it is today: *synchronization* and *metering*. Both problems stem from the fact that flash usually involves a single brief burst of light rather than a continuous and steady glow.

5.5 The flash tube from a Quantum Instruments unit. While most units have straight bare tubes, this one is pretzel-shaped to maximize tube length in a small space. It is enclosed in a protective glass shell.

5.4 The first challenge: flash synchronization

Flash synchronization simply means firing the flash simultaneously with the shutter opening up so the light correctly exposes the film or image sensor. Ambient lighting doesn't require synchronizing with anything because the output from the sun or a light bulb is constant and doesn't vary much through the course of an exposure. But if a flash fires before the shutter has opened or after the shutter has closed, then it'll obviously be pretty useless.

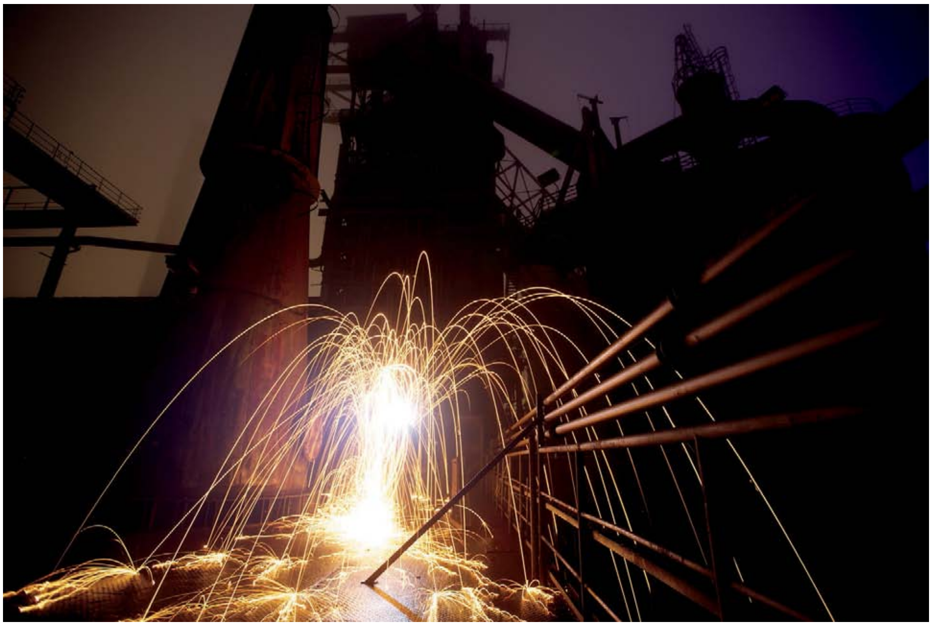
5.5 Open flash

KEY POINT
The millisecond pulse of light from a flash unit must be precisely timed—or synchronized—with the camera's shutter for proper exposure.

The simplest way to synchronize a flash with the shutter is to do it manually, just like Riis with his magnesium powder. The camera is put into a dark or low-light area, the shutter is opened up, the flash is fired by hand, and then the shutter is closed. "Open flash" works, but the technique is obviously limited to dark or near-dark conditions. Requiring long exposure times and careful manual work, this method was the only way to synchronize flash until around the 1930s.

It may be simple, but open flash is still used today for special purposes such as night photography. It can also be used for high-speed flash photography, as described in section 15.9. ☐ 5.6

5.6 This shot was lit by two light sources: the candles and a red-filtered 580EX II, which was fired manually twice at full power on the other side of the left-hand portal. EOS 5D Mark II, 30 sec at *f*/4, ISO 200, 35mm.



5.7 Landschaftspark Duisburg-Nord, Germany: What was once a bustling and polluted steel mill is now a park and monument to German industrial history.

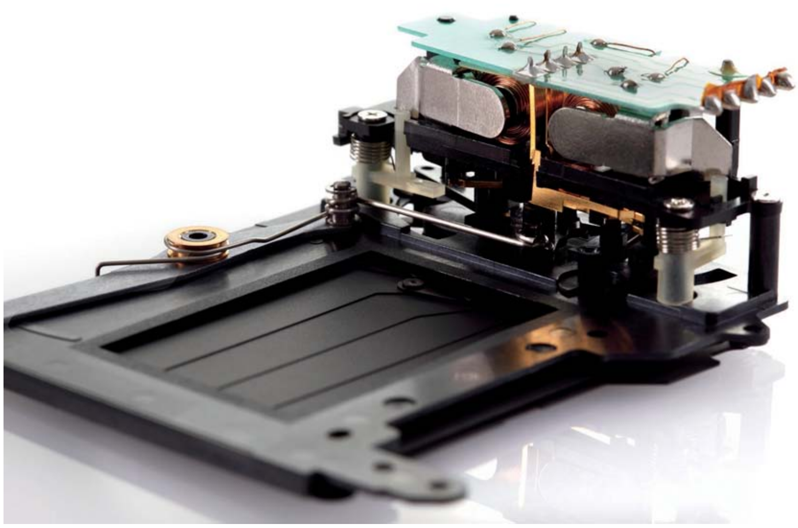
To create the whirling sparks, echoing the mill's original purpose, I spun some burning steel wool on a chain. However, in the first image, the towers ended up as dark silhouettes despite the 30-second exposure. For the second photo I spun the wire for longer, creating a bigger wheel, and then fired off two full-power bursts from a Speedlite 580EX, pointing at the blast furnaces. This open flash helped pick up details in the structure.

5.6 Flash sync

KEY POINT
Automatic flash sync fires the flash once the camera shutter is fully open. All EOS cameras have this basic capability.

Because open flash is inconvenient—and useless in bright ambient light situations—automatic flash synchronization was developed. At first glance, flash sync doesn't seem very complicated. After all, a flash could simply be rigged to fire when the shutter release button is pressed. But this approach doesn't actually work, because flash pulses are incredibly short in duration. Even the quickest mechanical shutters aren't fast enough. By the time they open fully, the brief pulse of electronic flash will already be over. Flash must therefore be fired *after* the shutter has opened all the way up, and not before.

By the 1950s, most quality cameras had shutters equipped with switches to detect when they were open and ready for the flash to fire. Sync for electronic flash became known as "X-sync," probably in reference to xenon gas. (X-sync can also refer to maximum shutter speed with flash, which is described in section 7.11.) ▢ 5.8



5.8 The shutter mechanism from a Canon EOS camera. The copper coils are electromagnets which move the silver-colored paddles, opening and closing the shutter blades. The tiny thin gold fingers are metal contacts that open or close as the shutter mechanism operates, enabling flash sync.

Other forms of flash sync, now very much obsolete, include M sync for "medium-speed" flash bulbs and FP sync for bulbs for "focal plane" shutters. The metal burning inside flash bulbs took a little time to reach optimum brightness. Such bulbs actually had to be fired before the shutter was fully open, hence the different sync modes.

5.7 Controlling flash exposure

In regular (non-flash) photography, you've got three basic ways to control the exposure of an image.

1. Shutter speed. The length of time that the shutter is open affects the duration of the exposure, since ambient light is essentially constant.
2. Lens aperture. The adjustable size of the diaphragm on most lenses governs the quantity of light that enters the camera.
3. Sensitivity of the digital sensor (ISO) or the film speed.

There is one critical way in which flash differs from ambient lighting. As noted on the previous page, flash bursts are so brief—sometimes just a few milliseconds—that a mechanical shutter is too slow to control how much light from a flash unit will hit the film or sensor (an exception being high-speed sync mode, discussed in section 7.12). Therefore, shutter times only affect the exposure of ambient light.

There are five basic ways to control exposure when using a flash unit, though the first four have drawbacks because they affect other things as well.

1. Lens aperture: Aperture settings also affect the amount of ambient light striking the film or sensor, as well as the picture's depth of field.
2. Distance from the flash unit to the subject: The amount of light illuminating an object decreases the farther it is from the light source. This follows known physical laws (the inverse square, section 7.14) and can be reliably calculated. Moving the light around might be acceptable in a studio setting but would be a hassle for casual or journalistic photography. Also, altering flash unit/subject distances affects the relative size of the flash light source, which in turn affects the quality of the light and shadows.
3. Sensitivity (ISO setting) of the digital sensor or film speed: This affects both ambient and flash exposure, and also the noisiness/graininess of the image.
4. Diffusers or light baffles between the flash unit and subject: These can be inconvenient, and they also affect the quality of light.
5. Adjustments to the energy output or the duration of the flash pulse: This last method is the most useful since it doesn't affect ordinary exposure of ambient light in any way. The adjustments simply affect the intensity of the flash produced.

KEY POINT
Regular flash exposure usually isn't affected by shutter speed settings.

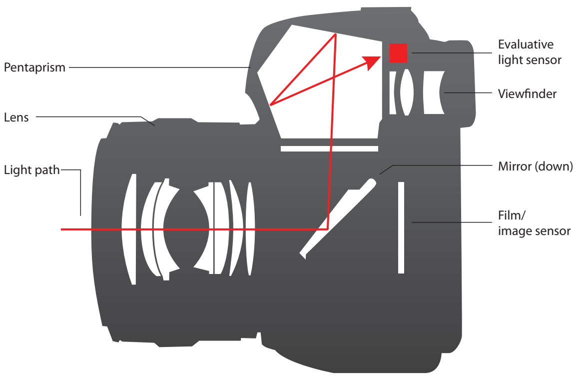
5.9 The size of the lens aperture controls the amount of light (ambient or flash) that enters the camera.

KEY POINT
Flash metering is the technique for determining the correct light output of a flash unit in order to expose a scene correctly. EOS cameras can handle this process automatically or let the photographer do it manually.

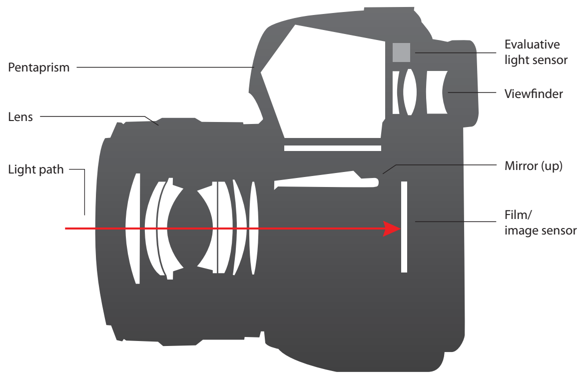
5.8 The second challenge: flash metering

Flash metering, or figuring out how bright the flash unit's pulse of light has to be, is a more complex issue than synchronization. In most SLR cameras, metering for available light occurs when the photographer looks through the viewfinder and presses the shutter release halfway down. The evaluative (ambient) light sensor, located inside the viewfinder assembly, has light shining on it whenever you can see things through the viewfinder. □ 5.10

When the mirror lifts up and the shutter opens to expose the film or sensor, light stops reaching the viewfinder and the ambient sensor. So a subject-illuminating flash pulse can't be measured by the ambient light sensor when the shutter is open. Over the years engineers have come up with four basic ways to get around this problem and meter for flash: one manual and three automatic. □ 5.11



5.10 The red line indicates light entering an SLR camera, bouncing off the mirror and prism, and hitting the internal light sensor.



5.11 However, when an SLR's mirror raises to take a photo, light no longer hits the sensor, so the camera can't record light levels anymore.

5.8.1 Manual metering

The oldest way to meter for flash is to do it by hand. You can manually measure some test flashes using a special handheld flash meter, perform distance calculations based on the known power output of the flash unit, or just take some trial and error shots while reviewing the camera's preview screen, if you're shooting digital. You then set the output level of the flash unit by adjusting the device manually.

KEY POINT
All-manual flash metering, while technically very simple, has gained a new lease on life in the digital age.

5.8.2 Automatic flash-based (autoflash) metering

Amazingly, a fast-reacting electronic system can measure the strength of a flash pulse while it's actually being emitted. Such a system detects light reflecting off the subject back to the flash unit, and cuts off power to the flash tube when adequate exposure is accomplished. This is done via a spe-

cial flash sensor built into the unit itself, and is the basis for the *autoflash* metering used by many flash units sold in the 1970s.

5.8.3 Automatic camera-based (TTL) metering

This method is the similar to above, but the flash sensor is inside the camera and thus measures light directly entering the body, hence the name "through the lens." TTL is compatible with film cameras only.

KEY POINT
Automatic *through-the-lens* (TTL) flash metering is used by EOS film cameras, and indeed most film SLRs sold in the 1980s and 1990s.

5.8.4 Automatic camera-based preflash (E-TTL) metering

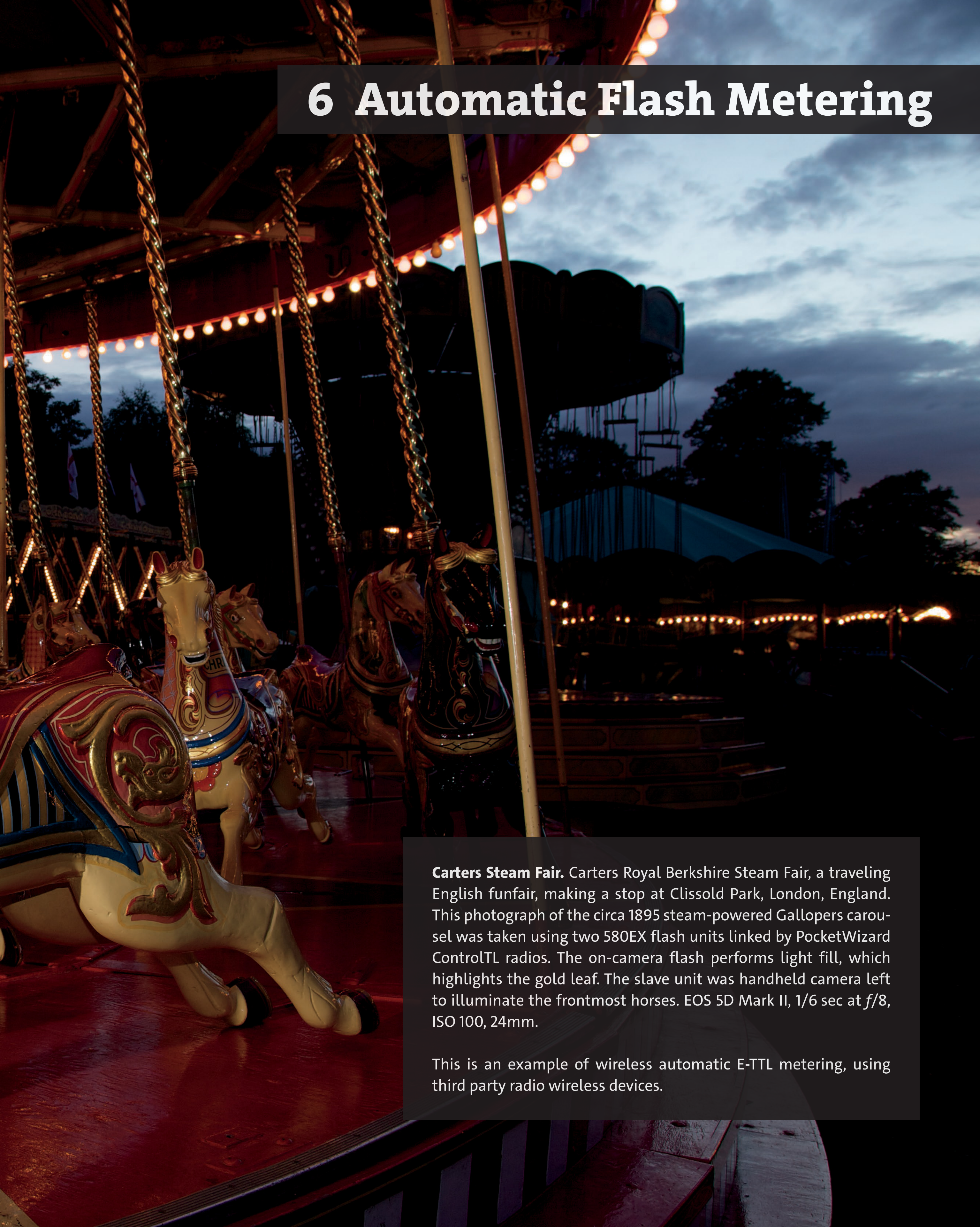
Here the flash unit fires a test pulse (preflash). The camera measures the reflected light using the same light meter that it uses for ambient light. Then the camera mirror is raised, its shutter is opened, and the flash unit fires the actual scene-illuminating flash. Canon refers to this method as E-TTL, for *evaluative through-the-lens* flash metering.

To summarize, there are three basic methods for automatic flash metering. Of those three, autoflash is rarely used today. Pre-1995 Canon EOS film cameras employ TTL metering, whereas later EOS film cameras and all EOS digital cameras use E-TTL (preflash) metering. Other systems employing preflash metering include Nikon iTTL, Pentax P-TTL, and Sony Pre-flash TTL.

KEY POINT
Automatic *flash metering with preflash* (E-TTL) is used by EOS digital cameras and post-1995 EOS film cameras.


ASHLEY
SONNY
SETH

6 Automatic Flash Metering



Carters Steam Fair. Carters Royal Berkshire Steam Fair, a traveling English funfair, making a stop at Clissold Park, London, England. This photograph of the circa 1895 steam-powered Gallopers carousel was taken using two 580EX flash units linked by PocketWizard ControlTL radios. The on-camera flash performs light fill, which highlights the gold leaf. The slave unit was handheld camera left to illuminate the frontmost horses. EOS 5D Mark II, 1/6 sec at *f*/8, ISO 100, 24mm.

This is an example of wireless automatic E-TTL metering, using third party radio wireless devices.

As described in the previous chapter, there are two basic ways in which flash is commonly used today: automatic and manual.

All Canon EOS cameras can use built-in popup flash units, clip-on Canon Speedlites, or other compatible units fully automatically. These devices rely on sophisticated light sensors, complex computer programs built into each device, and the ability of the devices to “talk” with each other. This technology is almost all proprietary to Canon, though a few third-party manufacturers have been able to produce compatible products.

Cameras by other manufacturers work in similar ways, though the specifics and terminology can be a little different.

6.1 Enabling internal flash and external Speedlites

Most EOS cameras with built-in flash have a flash button marked with a lightning bolt icon (⚡), typically on the left side of the camera body. Pressing the button pops up the flash head and charges it almost instantaneously. □ 6.1

An *external* flash unit isn’t much more difficult to use: just load it with fresh batteries, slide it into the metal bracket on the top of the camera, and turn it on. If it’s a Canon Speedlite or compatible automatic flash unit, the camera will immediately recognize it and adjust itself accordingly. □ 6.2

6.1

6.2

In either case, the camera will fire the flash unit automatically when a photograph is taken. Exactly how the flash will behave depends on a variety of settings and conditions.

6.2 Subject and background in flash photography

A photo lit by a single flash unit has two basic regions, which are determined by the distance to the flash tube. The *foreground* or *subject* is the part of the scene that is illuminated by flash. It usually, though of course not always, covers the area that is in focus. The *background* is everywhere else and is often lit entirely or mostly by ambient light rather than by flash.

Foreground versus background is an important distinction because all flash units have a limited range. As noted in the FAQ section, a small flash unit can't illuminate the Eiffel Tower, the Grand Canyon, or even a large indoor space such as a ballroom. For details, see the section on the inverse square law (section 7.14).

This picture of the Great Buddha of Kamakura, Japan, shows how on-camera flash can illuminate nearby objects but can't reach much farther. The result is a somewhat disappointing picture: the foreground is overexposed by the flash while the background is underexposed. ◻ 6.3

KEY POINT
The foreground in flash-illuminated photos is usually the area lit by flash.

6.3

6.3 Ambient light metering versus flash metering

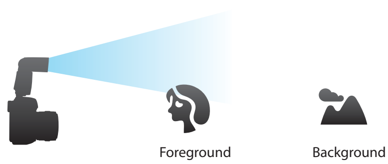
From the camera's point of view there are two light sources being used at the same time when a flash unit is fired. Except in total darkness, there will always be some ambient lighting, which is any available light (such as reflected light from the sun or artificial light sources). The camera has no direct control over this lighting. Instead, the camera—and you, the photographer—can specify how much of that ambient light hits the film or sensor by adjusting the aperture, shutter speed, and ISO settings. But in the case of automatic flash, the output from the flash unit is fully under the camera's control. The camera can specify when the flash fires and how much light it produces, up to its maximum output.

KEY POINT
Flash photography can be thought of as a kind of *double exposure,* or a photo with two separate lighting zones. Control over ambient light metering (measuring the amount of light illuminating a scene as is visible to the eye) and control over flash metering (measuring the output of a flash unit) are always handled separately and independently.

6.4 Freezing motion

The freezing of motion in a flash photograph is one area where the differences between ambient and flash lighting matter a lot. The duration of the pulse of light from a flash tube is extremely short, often between 1/750 and 1/1000 second. Exposures this brief mean that flash photography can be extremely effective for freezing motion even when a longer shutter speed is used.

This is why a photo taken with flash may seem sharper and crisper than one taken without. Areas of the photo lit predominantly by normal flash essentially have a shorter exposure time because of the flash pulse. The brief exposure allows less time for motion blur to occur. However, areas of the photo lit mainly by ambient light may not appear as sharp if a longer exposure time is used and either subject or camera motion occurs.



6.4

6.5 Although the shutter speed for this photo was only 1/60 second, it was taken in low-light conditions. The brief burst of light from the blue-filtered flash unit behind the model's shoulder has frozen the spray of water droplets in the air. The spray, incidentally, was accomplished by a very high-tech technique that involved crouching on the floor with a hand-pumped houseplant sprayer. The two bright octagonal areas are actually water drops on the surface of the lens. Each drop has eight sides because the lens has an eight-blade aperture diaphragm.

6.5 Normal flash sync

The usual mode for automatic flash operation, especially when light levels are low, is to use a brief shutter speed to keep blurring caused by camera movement to a minimum. The flash unit, controlled by the camera's flash metering system, then fires enough light to illuminate the foreground. This typically leaves the background dark, which is what most people experience when using flash on a simple point-and-shoot camera.

Canon EOS cameras work this way when in P (Program) mode, in most of the icon modes including green rectangle ( ) mode, and when using either a built-in flash or an external Speedlite.

While simple to use because it's so highly automated, normal flash sync can sometimes yield unattractive results, especially when ambient light levels are low. The way flash lights up the foreground subject, leaving the background veiled in darkness, is the usual reason.

6.6 The classic "Disappointing Tourist Photo," taken with a normal flash sync. The camera keeps the shutter speed short to allow hand holding and blasts the scene with flash. This picture has such a dark background that it could have been taken anywhere.

6.6 Slow shutter sync

Another way to take flash photos when light levels are low is to leave the shutter open longer. This lets more of the background show up while still illuminating the foreground subject.

6.7 Same scene as previous photograph. Here a slow shutter speed of about a second was used to let the background expose properly. Because of the long exposure time, this technique requires that the subject remain absolutely motionless and that the camera be securely attached to a tripod.

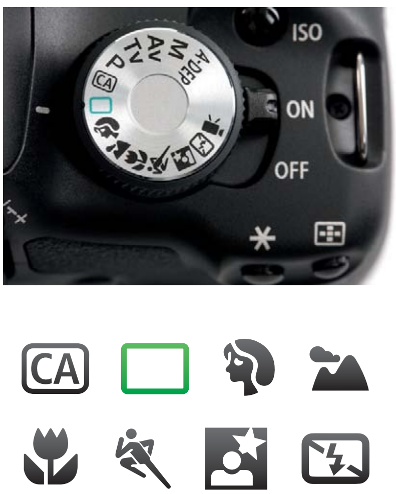
This technique is called *slow shutter sync,* slow sync, or “dragging” the shutter, and it demonstrates the double-exposure nature of flash photography. Some camera systems, notably Nikon, have explicit settings for slow shutter sync. EOS cameras don’t, since it’s basically just a function of long shutter speeds used with flash, but you can use this technique in Tv or Av modes. It’s also available in M mode, if the shutter speed is long enough, as well as in the night icon mode on most Canon consumer cameras. Slow shutter sync is never used in other automatic modes.

Photographing someone in front of a famous landmark at night is a classic scenario for using slow shutter sync. If the shutter speed is kept brief, the result will be a flash-illuminated person standing in front of a pitch-black backdrop (unless the landmark is extremely brightly lit or unless a high ISO or fast film is used). But by specifying a longer exposure setting (shutter speed), you’ll get a photo of a person standing against a properly exposed background.

6.8 This is the result of camera motion during the exposure. The flash-lit areas are sharp and clear, but other parts of the image are badly ghosted and blurred.

Changing shutter speeds in slow shutter sync is a way of adjusting the ambient (background) light levels while the flash-illuminated (foreground) light remains constant. But the drawback is obvious. By slowing the shutter speed, a tripod may be needed to avoid camera motion blur, especially with long shutter speeds like 1/30 second or slower.

6.7 EOS flash and icon modes



6.9 Flash icon modes

Most consumer and midrange EOS cameras have a selection of icon modes with pre-programmed settings to make it easier for beginners. Each mode has been crafted by the camera’s engineers to be generally useful for taking the type of photo indicated by the icon.

Icon modes, sometimes called Basic Zone modes, give most of the control of the camera over to its built-in computer and software. You really only have control over when the photo is taken, where the image is focused, and the focal length in the case of a zoom lens.

While quick and convenient, the icon modes aren’t necessarily a good way for beginners to learn how cameras work. Most internal settings can’t

be altered and the interaction between those settings isn't very obvious. In fact, icon modes can arguably be misleading sometimes. For example, the macro icon mode in an SLR can't alter a lens in any way that makes it better at taking closeup photos.

When using the four modes below, the popup flash will raise and fire if light levels are low enough and there's nothing attached to the hotshoe. The autofocus assist light (section 9.7) will also go on automatically if required. Night Portrait is the only mode that permits slow shutter sync. All other modes use "normal" flash, much like Program mode.

Full auto (green rectangle), Portrait, Macro, Night Portrait

In the following three modes, the popup flash won't raise automatically and won't fire even if raised or turned on. Also, the AF assist light will not go on.

Landscape, Sports, Flash Off

6.8 CA (creative auto) mode

Many recent EOS cameras aimed at the consumer market have a mode known as "CA" for "creative auto." This is basically an enhanced green rectangle mode, which attempts to explain the *consequences* of adjusting various settings rather than simply letting the user change them. It's a kind of an educational tool. For example, altering the lens aperture is described as making the background more "blurred" or more "sharp."

Flash control in CA mode is limited to auto (flash will pop up if light levels are low), on (flash always fires), or off (flash never fires). In other respects, CA mode operates like P mode and does not use slow shutter sync.

6.10

6.9 EOS flash and ambient metering: a source of confusion

Beyond the pre-programmed icon modes, virtually all EOS bodies provide four basic modes for setting the shutter speed or aperture based on ambient or available light levels: P (program auto-exposure), Tv (shutter speed priority or time value), Av (aperture priority or aperture value), and M (metered manual). These four modes, supplemented by DEP/A-DEP and bulb on certain models, are sometimes referred to as the “creative” auto-exposure modes by Canon (not to be confused with “Creative Auto”), since they give you more control.

These different metering modes specify the way available light is measured. They also handle flash differently, especially when ambient light levels are low. While logical in their own way, the differences between ambient metering modes on Canon EOS cameras are the primary source of flash-related confusion for beginners. They can also confuse people used to other camera systems, particularly Nikon, which operate on a different set of assumptions.

Here’s a summary of how the four fundamental exposure modes work when either a built-in flash or an external Speedlite is turned on. This summary assumes that high-speed sync is not enabled (section 7.12). It also refers to a camera’s X-sync value, which is the highest shutter speed a given camera model can use with flash (section 7.11).

Exposure Mode	Shutter speed	Lens aperture
P (Program)	Automatically set by the camera’s built-in computer, from 1/60 sec to the camera’s maximum flash-safe (X-sync) speed	Automatically set by the camera according to ambient light levels
Tv (Shutter speed priority)	The photographer can set any shutter speed between 30 seconds and the camera’s maximum X-sync speed	Automatically set by the camera, based on ambient light levels and the shutter speed set by the photographer, in order to achieve adequate exposure.
Av (Aperture priority)	Automatically set by the camera, from 30 seconds to the camera’s maximum X-sync speed, to yield sufficient ambient exposure based on the aperture setting	The photographer can set any lens aperture available (i.e., any of which the lens is capable)
M (Metered manual)	The photographer can set any shutter speed between 30 seconds and the camera’s maximum X-sync speed	The photographer can set any lens aperture available

6.10 Program (P) mode

In Program (P) mode, the camera chooses both shutter speed and aperture settings based on its reading of ambient light levels and according to a software program run by its computer; hence the name. Modern point-and-shoot cameras usually work this way.

When using either a built-in flash unit or an external Speedlite, P mode operates in one of two ways, depending on how bright the ambient (existing) light levels are.

P mode will not allow exposures to be shifted with the main control dial when automatic flash is used.

- If ambient light levels are fairly bright (above 13 EV, see section 7.17), then P mode assumes that you want to gently fill flash (see below) the foreground subject. It meters for ambient light and uses flash, usually at a low-power setting, to fill in (brighten) the foreground with supplementary light.
- If ambient light levels are not bright (below about 10 EV), then P mode assumes that your goal is to illuminate the foreground subject with the flash. It sets a shutter speed between 1/60 sec and the fastest X-sync speed (see above) the camera can reach. The aperture is determined by the camera's built-in program.

KEY POINT
The overriding principle of Program (P) mode in Canon EOS flash photography is that the camera tries to set a high shutter speed so that the camera can be held by hand without a tripod. If that means the background is dark, so be it.

6.11 Tv (shutter speed priority) mode

Tv

In this mode, you choose a shutter speed by rotating the main dial next to the shutter release button. The camera then automatically chooses an aperture setting to expose the background correctly. Since you explicitly specify the value of the exposure time, the Canon abbreviation for this mode is "Tv," for "time value," though other brands refer to it as "S" for "shutter speed" mode. Flash output is determined automatically and separately by the flash metering system.

If the maximum aperture value of the lens starts blinking in the viewfinder, it means the background of the scene is too dimly lit, and the shutter speed should be decreased to compensate. Otherwise the camera will just try to expose the foreground with flash, and the background will come out dark. Naturally, at slower shutter speeds, a tripod will be needed to avoid blurring caused by camera shake.

KEY POINT
In Tv mode, EOS cameras always try to expose the background adequately, unlike P mode. In low-light conditions, Tv mode uses slow shutter sync.

If either the built-in flash unit or an external Speedlite is powered on, the camera will prevent you from selecting a shutter speed that exceeds the camera's maximum flash-safe (X-sync) unless high-speed sync is available and switched on. If the minimum aperture value of the lens starts blinking, the shutter speed is too long even with the lens fully stopped down, meaning that the scene is very bright and will be overexposed. The ways around the problem are to turn on high-speed sync, if it's available, use a lower ISO setting or slower film, or put a neutral density (light absorbing) filter on the lens. Alternatively, you can turn off flash altogether and simply use a reflector of some type to bounce ambient light onto the subject if required.

6.12 Av (aperture priority) mode

Av

KEY POINT
In Av mode, EOS cameras try to expose the (ambient) background correctly. If that means the shutter speed is a really long value, such that a tripod is needed to avoid camera-shake blur, so be it. In dark conditions Av mode uses slow sync.

In this mode, you choose a lens aperture value (*f*-stop) by rotating the camera's main dial. The Canon abbreviation is “Av” for “aperture value,” though it's often called “A” mode by other brands. The camera then chooses a shutter speed ranging from 30 seconds to the camera's X-sync speed, in order to expose the background correctly. Flash output is automatically determined by the flash metering system.

There is an exception. Many EOS cameras have a custom function that locks the shutter speed to X-sync, letting the camera behave more like P mode when in Av mode. Other models also have a custom function that chooses a shutter speed between 1/60 sec and X-sync, the way P mode does.

If either the built-in flash unit or an external Speedlite is powered on, then the camera won't exceed its built in X-sync speed unless high speed sync is available and switched on. If a shutter speed time of 30" (30 seconds) blinks in the viewfinder, then there isn't enough light to expose the background correctly and a larger aperture or higher ISO setting/faster film are required. If the camera's X-sync value blinks in the viewfinder, then the lens aperture must be decreased, high-speed sync turned on, if it's available, or a lower ISO/slower film used.

6.13 M (metered manual) mode

M

KEY POINT
In M mode, shutter speed and aperture determine how the background (ambient lighting) is exposed. The foreground, however, will still be illuminated automatically since the flash metering system operates independently of the ambient light metering system.

In manual exposure mode, you can specify both the aperture and shutter speed at will. It's therefore technically not an automated exposure mode, but one *assisted* by the automatic system since an exposure meter will appear in the viewfinder. However, this meter is just a guide, and the camera does nothing to override any ambient light setting chosen.

Using metered manual mode does not affect the flash system's control over flash output. Manual mode gives you complete control over ambient metering and assumes you know how to use it.

6.14 DEP (depth of field), A-DEP (automatic DEP), and B (Bulb) modes

B

DEP and A-DEP modes don't work with flash, and their metering settings revert to P mode if flash is turned on. In B, or bulb mode, the camera behaves as it would in M mode.

6.15 Fill flash

If ambient light levels are fairly high, such as outdoors during the day, flash can serve as a supplementary form of light. Flash can lighten shadows,

temper the harsh contrast of full sunlight, or brighten up dull images. This is called “fill flash,” “fill-in flash,” “balanced fill flash,” or “daylight synchro.”

Fill flash is often a source of surprise for non-photographers, who don’t expect to see flash units being used outdoors on sunny days or in brightly lit settings. In such situations, the fill flash serves as a sort of portable reflector, adding a little extra light. A backlit subject is a common situation for fill flash: exposure compensation can’t be used to expose the subject correctly, since the background would be overexposed.

Another classic example is a person with long hair or a hat on a sunny day. Hair and hat brims often cast dark shadows over a subject’s face, and a little flash can lighten up these shadows nicely.

As always, the amount of ambient light hitting the film or sensor is controlled by the lens aperture and shutter speed, while flash levels are set by flash metering. Adjusting the output of the flash unit essentially adjusts the ratio between the flash-illuminated subject and the ambient-illuminated scene.

In fact, one could argue that flash as primary light source versus ambient light as primary light source is an artificial distinction, and that all flash photography is fill photography in a sense. It’s just that, in the first case, the ambient lighting is so low as to be insignificant, whereas in the second case it’s the reverse. The distinction is nonetheless useful, particularly when considering the way full auto and P modes work versus Tv, Av, and M modes.

Automatic fill flash was one of the chief technical innovations in flash developed in the 1970s and ’80s. For decades, photographers knew that low levels of flash could be useful for filling in shadowed areas in a daytime photograph, but figuring out the right flash level for suitable fill required a lot of skill and experience before flash automation.

KEY POINT
Canon EOS cameras always default to fill flash mode when the camera is in Tv, Av, and M modes. They also perform fill flash in P mode if ambient light levels are high enough. There’s no separate switch or push button to engage fill flash on EOS cameras.

6.11 Nature photography can benefit from a little fill flash as well. Here, the flash prevented the heron from getting lost in the shade under the trees. The drawback was that it also overexposed the near branches to the right. Heian Jingu temple garden, Kyoto, Japan.

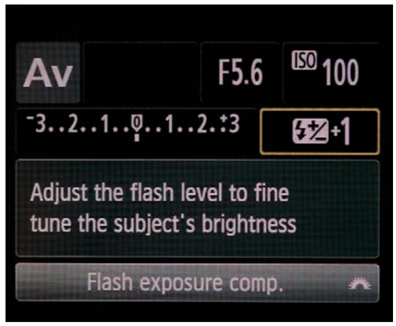
6.12 The Raygun Gothic Rocketship was designed and built by Sean Orlando (shown), David Shulman, and Nathaniel Taylor. The art piece made its debut at the annual Burning Man arts festival in Nevada's Black Rock Desert.
The first photo, taken at sunset following a dust storm, demonstrates the low foreground light compared with the background (essentially a backlight condition). In the second image, a fairly natural-looking photograph is achieved by applying fill flash to balance the foreground. EOS 5D Mark II, 580EX II, 1/80 sec at *f*/8, ISO 100, 40mm.

6.16 Fill flash ambient light reduction

There's one non-obvious exception to be aware of when using fill flash. EOS cameras that use E-TTL adjust exposure settings downwards when ambient light levels are low.

To test if a given camera reduces exposure settings, put the camera into Av mode and meter a fairly dark scene. Note the settings the camera wants to use, and then turn on a flash unit. Meter again, and there'll probably be a drop in the exposure settings of a half to a full stop. This unadvertised feature makes the foreground image pop a little, but may not always be what you might want.

6.17 Flash exposure compensation (FEC)



6.13

Sometimes you'll want to adjust a flash unit's power above or below the mid-tones that the camera anticipates. For example, a scene that's mainly white or mainly dark can fool automated sensors. A manual shift up or down in flash output is known as flash exposure compensation, or FEC. (It was called "fill-in ratio control" or "flash level control" in older Canon manuals.)

In a sense, FEC can be seen as the opposite of slow shutter sync, since it allows flash-illuminated (foreground) levels to be adjusted while leaving the ambient (background) levels untouched. FEC also differs from ordinary exposure compensation, which adjusts only ambient exposure levels on EOS cameras. Exposure compensation on some other systems, such as Nikon, adjusts both ambient and flash levels simultaneously.

As noted in the section on fill flash, a common use of flash is lightening shadows and toning down high-contrast sunlight. Adding a subtle catch-light or sparkle to the eyes is another. In cases like this, it may be necessary to dial in an additional minus stop or two of flash compensation over the camera's built-in flash program to avoid blasting out a ton of fill flash that would wash out the subject's face or cast flash shadows. The camera's default fill flash settings can be a little too bright and obvious, resulting in a cardboard cutout effect to portraits.

You might also want to override the default flash controls in situations that are hard for the flash system to meter. Wedding photos of a man in a black tuxedo in a large room, or a woman in a white dress next to a white cake, are common metering problems.

Flash compensation is enabled in different ways depending on the camera and flash unit in use (section 9.9).

7 Technical Topics

LRRY. LRRY is a walking, fire-breathing kinetic sculpture by artist Lyle Rowell. Constructed from scrap car and motorcycle parts, LRRY is powered by an automobile engine from a Citröen 2CV and is shown here at Mutate Britain's 2009 exhibition in London, England. Graffiti art by Elate and Vibez.

Two studio flash units were used: one snooted and camera left, and the other behind the machine for backlighting. One device was fired with a radio trigger, and the other responded to an optical slave. Manual power output on both flash units. No gels were used on the studio units, to provide bluish light as a deliberate contrast to the yellow propane flame.

This chapter covers fairly technical material: how modern flash technology works. I think it's pretty useful to know this stuff, as you're always better equipped to solve a problem if you understand the underlying reasons for why things are the way they are, but this isn't the easiest part of the book to digest. If you skip this chapter, it might be worth referring back to it later.

7.1 Canon EOS flash metering

As described previously, automatic flash metering on EOS cameras relies on the camera and flash unit working together in unison, and is essentially handled independently of metering for ordinary ambient light. Canon has, over the years, built two fundamental types of flash metering technologies into its EOS cameras: TTL, which is used only by film cameras, and E-TTL, which is used by all digital cameras as well as post-1995 film cameras. Here's how it all functions.

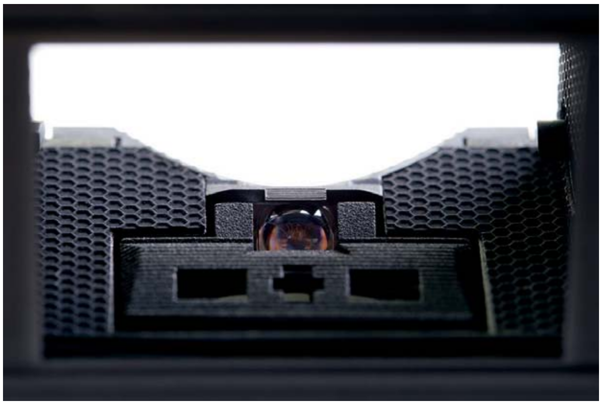
7.1 A digital EOS 500D (Rebel T1i) camera with Speedlite 430EX flash unit, attached to an optional SB-E2 flash bracket. Like all EOS digital cameras, this model uses E-TTL flash metering.

7.2 TTL flash metering

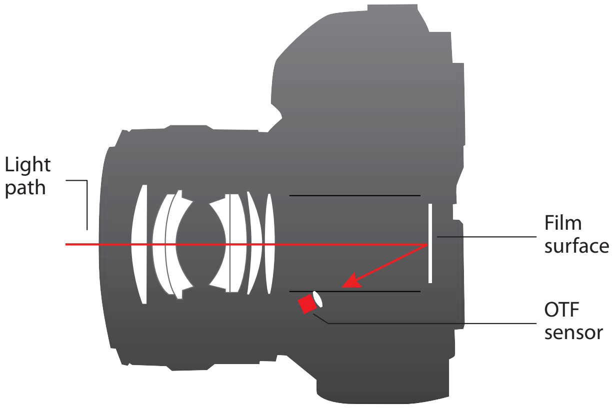
"Through-the-lens," or TTL flash metering, was pioneered by Olympus in the mid-1970s. The first Canon camera to use it was the legendary manual-focus T90 of 1986, and the feature was standardized in the EOS film lineup a year later. While virtually all EOS film cameras use TTL, it's now obsolete technology and not used on any digital camera.

TTL flash metering measures the amount of flash-generated light that bounces off the subject and back into the lens. The light sensor can't sit between the lens and the film, since that would obviously block incoming

light, so it's positioned at the bottom of the mirror box. It actually detects the light reflecting off the surface of the film itself, and is thus known as an off-the-film (OTF) sensor. The light produced by the flash unit is shut off, or "quenched," when the camera detects that enough light has been reflected back and that a satisfactory flash exposure must have occurred. ☐ 7.3



7.2 The base of a film camera's mirror box, looking from the film side of the camera. The small lens covers the TTL flash sensor. The other openings are for the recessed autofocus sensors.



7.3

While TTL is similar to autoflash (section 10.7) in that the scene-illuminating flash pulse is measured in real time as it's emitted by the flash tube, it differs significantly since the flash sensor is inside the camera and not on the outside of the flash unit. For this reason TTL flash must be designed into the camera from the ground up, and camera and flash unit must be able to communicate with each other. Technologically, this is very different from both manual flash and autoflash, which rely solely on a simple "produce light right now!" sync command from the camera body.

TTL records only the light that makes up the final image. Unlike autoflash sensors built into a flash unit, it can't be fooled by reflective objects outside the frame. TTL doesn't care if any light-modifying devices or filters are placed on the flash or lens, since it records reflected light and not the output of a device. TTL is highly automated, freeing you from the burden of calculating the distance from flash to subject or adjusting flash output settings.

Almost every EOS *film* camera supports TTL, with two exceptions described in section 7.6.1.

7.4 The Speedlite 540EZ, shown here on an EOS 5/A2E, was the top of the line flash unit for TTL-only film cameras.

7.2.1 TTL limitations

TTL has many drawbacks. The flash sensors can easily be fooled by highly reflective surfaces. TTL is designed to measure flash reflections off typical color negative film and can have subtle metering problems with other film types. TTL doesn't handle multiple flash units very well, and can't work wirelessly. And it can't be reliably mixed with manual flash.

TTL-equipped cameras have only one, three, or four flash sensors, depending on the model, versus the dozens of ambient light metering zones in modern bodies. Canon TTL flash sensors tend to misread off-center subjects, and can't distinguish between far-off reflective objects and less reflective objects close at hand. But these aren't the reasons TTL flash metering is no longer used today.

7.2.2 Digital cameras and TTL flash

The rise of digital photography caused a huge problem for engineers at Canon and other companies when they discovered that TTL flash doesn't work properly with digital sensors, which reflect light differently from film. Fortunately, TTL flash's successor, E-TTL (section 7.4), was already on the market and was successfully adapted for the new digital world.

When shopping for an automatic flash unit for a digital EOS camera, be sure to avoid TTL-only devices such as non-EX (E or EZ) Canon Speedlite models, no matter what sellers may claim about their compatibility. TTL-only flash units, or any EX Speedlite set to TTL mode, will either fire at full power or not at all when used on a digital camera. For a comprehensive list, please see appendix C.

KEY POINT
TTL-only flash units (Speedlite E, EG, and EZ models) *cannot* meter automatically when used with a digital EOS camera. The same applies to EX Speedlites if set to TTL mode.

7.3 A-TTL flash metering

"Advanced" TTL is an obsolete flash metering variant available to TTL-compatible EOS film cameras when a Speedlite EZ model is attached.

In A-TTL mode, the flash unit fires a brief supplementary pulse of light during the metering phase, before the shutter actually opens. Speedlite EZ units have a special sensor to record light bouncing back from this preflash, and that data is factored into normal TTL operation.

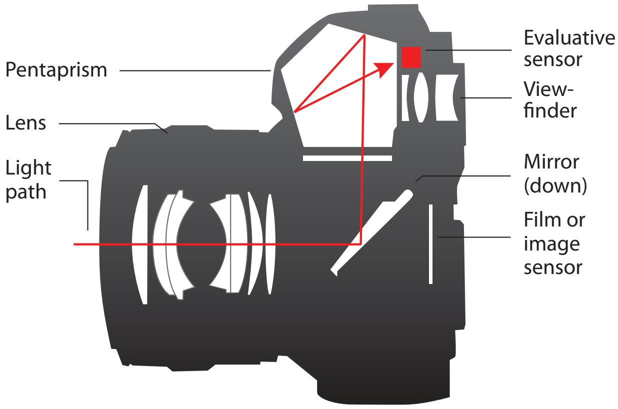
The preflash occurs when the shutter release button is pressed halfway. It's either invisible infrared from a secondary tube or visible white light from the main tube, depending on the model and the position of the flash head.

A-TTL, despite its name, offers no real advantage over regular TTL and was abandoned when E-TTL was introduced.

7.5 The round lens covers the A-TTL sensor. The glowing red area to the left of the sensor is the near-infrared prefire for A-TTL metering. It's basically an ordinary flash tube hidden behind a light-blocking plastic panel.

7.4 E-TTL flash metering

"Evaluative through-the-lens" (E-TTL or preflash) flash metering was introduced in 1995 and is the current way that all EOS cameras meter for flash. It's completely incompatible with TTL, and uses the same evaluative light sensor as regular ambient lighting. ☐ 7.6



7.6

7.7 The pentaprism from an EOS camera. The orange circuit board behind the clear plastic lens contains the ambient light sensor. This assembly is buried inside the top of the camera and can't be seen from the outside.

E-TTL works by firing a low-powered preflash of known brightness from the main flash tube. The reflectance of the preflash-illuminated scene is measured using the camera's normal evaluative light meter, and then the camera's computer calculates the light required to achieve a mid-toned subject. The camera flips up the mirror, opens the shutter, and instructs the flash unit to fire the scene-illuminating pulse at the pre-computed output level.

KEY POINT
E-TTL flash fires at least one low-power test flash for metering purposes prior to the actual scene-illuminating flash.

There are some important points here. First, the E-TTL preflash occurs right *before* the shutter opens and not when the shutter release is pressed halfway. It may be surprising to learn that E-TTL actually fires a preflash at all. Under normal circumstances, it happens so quickly that the preflash is difficult to notice—though it is quite obvious when using flash exposure lock (FE lock) or second-curtain sync and a long shutter setting. However, the preflash explains why a slight flash is visible when looking through the viewfinder: the final illuminating flash can't be seen through the viewfinder since the mirror is up at that point.

Second, the preflash is analyzed by the same evaluative metering system that the camera uses to meter normal ambient light. This means it meters through the lens and is harder to fool than external sensors; it isn't confused by bounced light, doesn't read anything off the surface of the film, and examines as many separate zones of the image as the metering system has.

E-TTL is generally superior to its predecessors at applying subtle and natural fill flash to daylight photographs. E-TTL exposure is also linked to the current AF focus point, which, in theory, results in finer-grained exposure biasing than TTL flash sensor systems (which only have one or three zones).

E-TTL requires both an E-TTL camera and an E-TTL flash unit. All Canon-designed EOS digital cameras, and EOS film cameras made since the mid-1990s, support it, but older TTL cameras can't use it. All Canon Speedlite flash units with "EX" in the name speak E-TTL.

7.8 Canon EOS digital cameras and Speedlite EX flash units are all interchangeable. You could even put an enormous 600EX-RT onto a teeny EOS Rebel SL1/100D if you wanted to. It'd work perfectly, though it's a bit topheavy!

7.4.1 Limitations of E-TTL

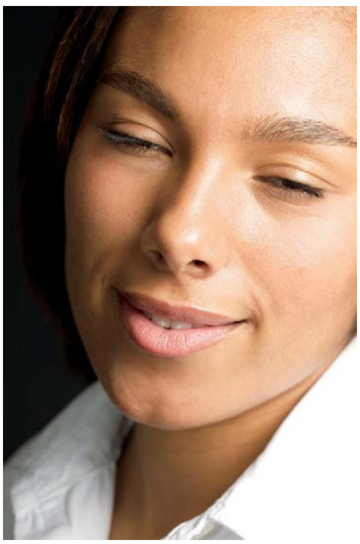
E-TTL has seen a good deal of development over the years. Many early E-TTL film cameras didn't support wireless flash ratios or modeling flash. Early EOS digital cameras also had problems with E-TTL metering. Canon has improved its flash algorithms, and the introduction of E-TTL II has helped, so the inconsistent flash metering that plagued the first EOS digital models is less of an issue with current cameras.

More abstractly, E-TTL is a very automated system, and it's not always immediately obvious how it'll respond to different light conditions. However, there are a few key issues to be aware of when using E-TTL.

The main issue is that E-TTL links to, or emphasizes, the active focus point when using autofocus. In other words, it makes the assumption that the current active focus point is located over the primary subject. When that isn't the case, or when the subject is particularly light or dark, flash metering problems can occur.

This is one of the causes of flash metering errors when using the traditional "focus and recompose" technique. Since flash metering occurs *after* ambient light metering, focus and recompose will lock ambient metering but not flash metering. The recomposing stage will then probably confuse the flash metering.

To avoid this problem, select the focus point that's closest to the subject in order to bias flash exposure to that area, use flash exposure lock (FE lock) to lock down flash metering, or switch the lens to manual focus. Since there are no AF points in manual focus mode, E-TTL will average exposure across the frame. These techniques all have their drawbacks, and this aspect of E-TTL is addressed by E-TTL II (see below).



7.9 E-TTL eye droop.

7.10 Even birds aren't immune to the phenomenon.

Another problem with E-TTL is that the preflash can capture people with sensitive eyes in mid-blink, even though a miniscule amount of time passes between the preflash and the main flash. It's not uncommon for group photos to feature a number of droopy or closed eyelids. A similar problem can affect nature photographers who photograph skittish birds. The problem is heightened when using second-curtain sync with slow shutter, since a longer period of time can elapse between the preflash and the flash.

The only reliable way around the issue is to fire the preflash manually by pressing the FE lock button, waiting a moment, and then taking the actual photo. When using FE lock (section 9.10.1), it's wise to warn the subjects that there'll be two flashes; otherwise, they might look away after the preflash, thinking the photo has already been taken.

Finally, the E-TTL preflash can prematurely trigger optical slave flash units that work by detecting the light from the triggering flash (section 11.7.3). This results in the main flash being underexposed or nonexistent, since the optical slave is triggered too soon. The preflash can also confuse handheld flash meters.

7.5 E-TTL II

E-TTL II, introduced in 2004, is a refinement of E-TTL that brings improved algorithms and distance data to Canon DSLRs. E-TTL II doesn't require any changes to either the flash units or lenses used with an E-TTL II camera—the changes are all internal to the camera. Cameras that support E-TTL II always do so; there's no "fallback" to E-TTL. An older camera cannot be upgraded to E-TTL II.

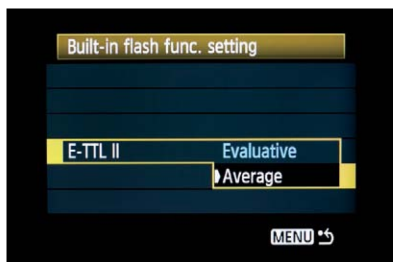
7.5.1 E-TTL II's improved flash metering algorithms

E-TTL II examines the camera's central evaluative metering zones both before and after the E-TTL preflash goes off. Any areas with relatively small changes in brightness are weighted, or given greater priority. This reduces the E-TTL problem of reflective materials throwing off flash metering. The camera ignores the metering zones around the periphery of the frame during flash metering, since it assumes that the subject won't be close to the edge.

In a sense, E-TTL II meters flash data across an imaginary flat plane rather than at a point, and the area being metered for flash depends more on the subject size. It also meters the same regardless of whether autofocus or manual focus is used.

Normally, E-TTL II uses evaluative algorithms for its flash metering, but some cameras can use averaging rather than evaluative for flash metering. This option may be useful when using lenses with no distance data. □ 7.11

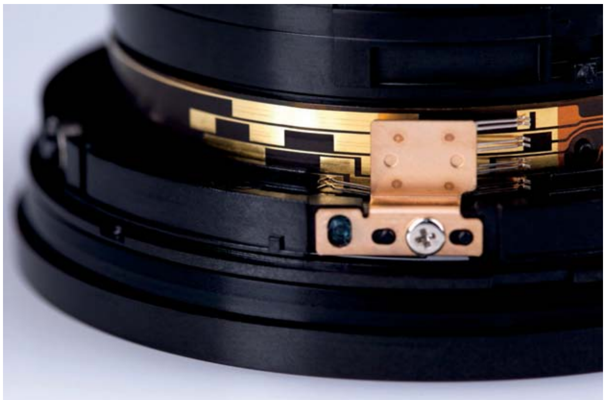
KEY POINT
Unlike E-TTL, E-TTL II never links exposure to the active focus point.



7.11

7.5.2 Distance data

Most Canon EF and EF-S lenses contain rotary encoders that detect the approximate distance from the camera to the subject in focus. In certain cases, E-TTL II can factor in this distance when calculating flash output. This is mainly used for confirming if a highly reflective or nonreflective area is at the same distance from the camera as the subject that's in focus. Distance data is useful when using focus and recompose without setting FE lock; E-TTL II can help minimize flash metering errors under these conditions.



7.12 Magic encoder ring. This is what the distance encoder from an EF 70–200 4L lens looks like.

7.5.3 Cases in which distance data is not used

E-TTL II uses distance data only for straight-ahead direct flash. Distance data isn't used when the lens can't provide it, when the flash head is tilted or swiveled, with macro flash, or with wireless flash.

When using bounce flash (when the flash head is in almost any position other than straight on), there's no way for the camera to know how far the light traveled to reach the subject from the flash unit. Light will have scattered off walls or ceilings or other surfaces. Since bounce flash is a common technique to improve the quality of a flash-illuminated scene, it means that the primary advantage of E-TTL II in this situation is just improved evaluative flash metering. There is one minor exception: when 500/600 EX series units have their flash heads tilted downward 7°, distance data is not disabled.

The remaining two conditions are similar. With macro flash, the camera is too close to the subject for the lens to determine useful information; and with wireless E-TTL flash, the camera has no idea where the flash units are positioned in relation to the subject.

However, E-TTL II can still use distance data if the flash unit is connected to a camera via an Off-Camera Shoe Cord (section 11.5.1). This means that users of flash brackets won't be left out. It also means that if the flash unit is positioned closer to or farther from the subject than the camera, or if the flash unit is pointed away from the lens axis while the flash head is locked in a straight-ahead position, then flash metering may be thrown off slightly. The use of distance data can't be disabled if the lens has it, though setting

7.13 The block fastened to the camera's hotshoe is part of an Off-Camera Shoe Cord, which serves as an extension cable for flash units.

the flash head to a slight off-center bounce position will disable distance data while not significantly altering the flash coverage.

The important point is that E-TTL II uses distance data when it's available and appropriate, but it doesn't *rely* on it.

7.6 Type A and type B cameras

When E-TTL was introduced, Canon clarified compatibility by designating E-TTL-compatible camera bodies as "type A" and TTL-only bodies retroactively as "type B." This terminology isn't used much today, since EOS cameras have supported E-TTL for 20 years.

There are also unlabeled subvariants of type A technology. The first generation of type A cameras does not support wireless E-TTL flash ratios and modeling flash; the second and third generations do. The third generation adds support for E-TTL II. Most type A film cameras support legacy TTL flash.

All EOS digital cameras are second or third generation type A and cannot support TTL. Finally, in 2012 Canon introduced radio wireless flash. Most EOS bodies released since then are "radio-aware" (see 11.11.3); earlier cameras can't support certain radio features.

7.6.1 TTL, E-TTL, and EOS film cameras

Nearly all EOS film cameras support TTL flash, and always use TTL for internal flash. But, for the sake of completeness, there are two exceptions: the EOS 300X/Rebel T2/Kiss 7 (same camera with different names for different markets) is a 35mm film camera that supports E-TTL II only, and the oddball EF-M is an EOS Rebel/1000 that uses Canon EF lenses but which lacks autofocus and TTL flash. A small autoflash, the Speedlite 200M, was sold uniquely for the EF-M. ☐ 7.14

7.14 A Canon EF-M film camera with its matching Speedlite 200M.

7.6.2 Kodak Digital Science (DCS) cameras

From 1995 to 1998 Canon and Kodak had an unusual partnership. They released EOS 1N film bodies with Kodak "Digital Science" units bolted onto them. These DCS models were the DCS 1, DCS 3, DCS 5, DCS 520, DCS 560, D2000, and D6000. Most used modified TTL, and had poor flash metering.

Hardly any were sold. So while it's technically true that the first digital EOS bodies spoke TTL, in real life it's fair to say that virtually all EOS digital bodies, certainly from the D30 on, are E-TTL only.

7.7 Flash technology availability summary

- TTL/A-TTL and E-TTL are incompatible systems. Many EOS film cameras can use either one, but the two metering technologies cannot be used together.
- Older EX-series (i.e., E-TTL capable) flash units also support TTL metering and will automatically revert to TTL metering when used with an older type B camera. However, newer low and mid range EX series units are E-TTL only.
- Nearly all EOS film cameras support both TTL and A-TTL metering. They can all use most E-series flash units in TTL mode and EZ-series flash units in A-TTL mode.
- EOS digital cameras support either E-TTL or E-TTL II. They don't meter automatically with TTL-only units, or with EX-series units in TTL mode.
- From 2012 on, most EOS digital bodies are "radio aware" (see section 11.11.3).
- If the camera and flash unit support both TTL and E-TTL (i.e., the camera is a type A film body and the flash unit is an EX model), then E-TTL will be used unless specifically overridden by on-flash controls.

7.15 This tiny Speedlite 90EX works fine with all EOS digital cameras, even huge ones like this. However, the 90EX will not work with any TTL-only film camera.

7.8 Metering patterns

Unlike our eyes and brains, which can interpret the importance of parts of a scene, a camera simply detects a rectangular field of reflected light. It has no idea what's important and what's not. Consequently, a number of different ways of measuring ambient (available) light levels have been developed by camera makers. The application of these patterns depends on the camera model, user settings, and whether ambient light or flash is being metered.

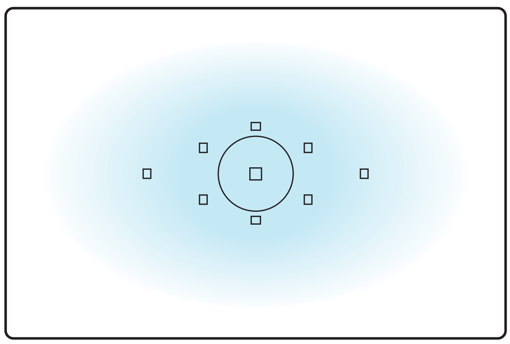
7.8.1 Ambient metering and metering patterns

All EOS cameras contain light meters tucked away inside the top of the viewfinder (section 5.8). These electronic devices measure light levels and are used by the camera's computer system to set the exposure automatically.

There are a number of ambient metering patterns used in Canon EOS cameras. Most digital EOS models let you select any mode you want, so long as the camera is in a letter mode for metering (P, Av, Tv, M, B, DEP). However, some earlier models did not permit user selection of metering modes and chose them according to built-in programs.

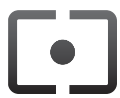
7.8.2 Center-weighted average metering

This is one of the simplest ways to meter ambient light, commonly found in SLRs of the 1970s. The camera's light meter measures light across the entire frame. If it's center-weighted, it gives additional importance (weighting) to the area around the center. □ 7.16

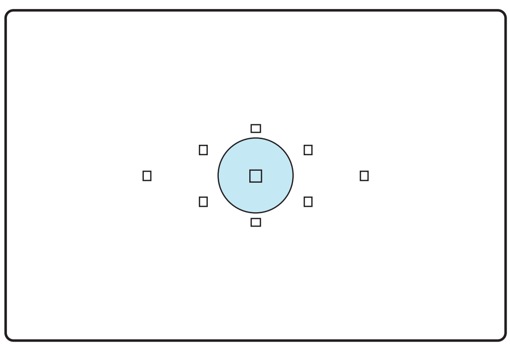


7.16

7.8.3 Spot metering



The camera measures the light around a very tiny section of the entire frame, typically 2 to 4 % of the total frame area. Usually, the spot is right at the center of the frame, but on some cameras it can be around the active autofocus point. This more advanced form of metering, favored by professionals, requires you to select the area to be metered very carefully. □ 7.17

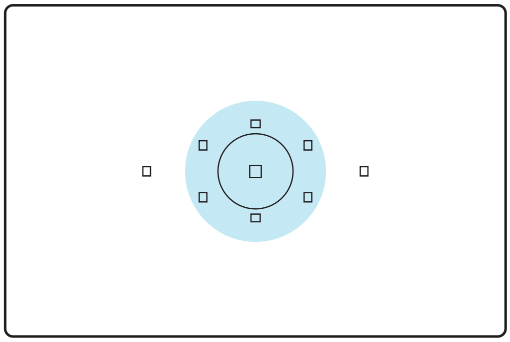


7.17

7.8.4 Partial metering

This pattern is considered sort of a fat spot. The camera measures the light around a larger area, typically 8 to 10%. Though less precise than spot metering, partial is more forgiving and easier to use. □ 7.18

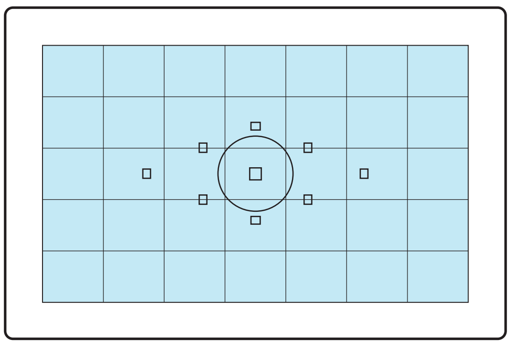
7.18



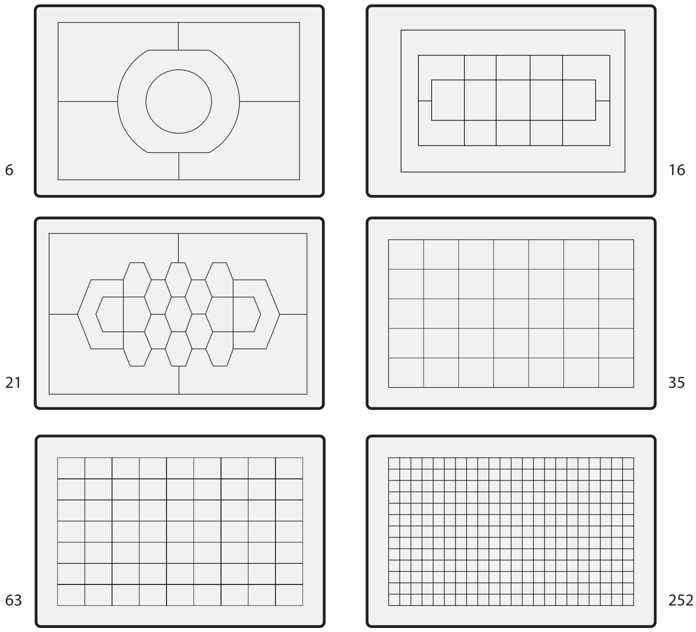
7.8.5 Evaluative metering

The most automated form of metering, evaluative metering divides the frame into a series of small cells or zones. Complex computer programs inside the camera examine the light levels recorded by each cell and analyze them using proprietary software. □ 7.19

7.19



Canon has used many types of evaluative metering sensors over the years, ranging from early EOS cameras, which divided the frame into a mere six zones, to the latest 252-zone sensors. This type of metering is called multi-zone or matrix metering by other camera makers. □ 7.20



7.20 Some of the different evaluative metering patterns used by EOS cameras over the years, from 6 to 252 zones. The latest models also have multi-layer sensors (iFCL for Intelligent Focus, Color, Luminance, or RGB for Red Green Blue) capable of distinguishing colors as well as brightnesses.

7.9 Flash metering patterns

In addition to metering patterns for ambient lighting, there are differences in the way flash metering is handled.

7.9.1 Film cameras and ambient metering with TTL flash

Film-based cameras vary from model to model in terms of how ambient light metering is handled when TTL or A-TTL flash is used. These stem from the fact that the camera needs to meter for the background and not the subject when using flash. Consequently, the camera's ambient metering patterns may change silently when flash is turned on.

Early EOS film cameras use center-weighted average or partial metering for the background when using TTL and A-TTL flash. Later film models with multiple metering zones just look at the outer segments of the evaluative metering sensor when using flash.

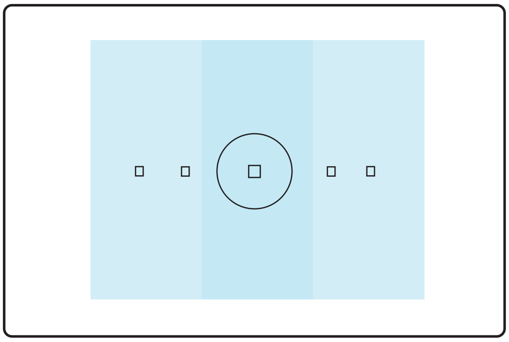
7.9.2 Digital cameras and ambient metering with E-TTL flash

When flash is enabled, most E-TTL cameras don't switch from the user-selected ambient metering pattern. However, 1 series cameras are different. When flash is enabled, these cameras switch to evaluative metering, but weight as if the center focus point is active. Flash on these models requires metering for ambient in a fashion similar to center-weighted averaging.

7.9.3 TTL and A-TTL flash metering zones

TTL and A-TTL flash have separate flash sensors and thus simpler metering patterns than those used by ambient light sensors. The earliest EOS film cameras have one focus point and a single flash sensor, which meters across the entire frame, so off-center subjects may meter poorly for flash.

EOS film cameras with multiple focus points have more than one TTL metering zone ("Canon Advanced Integrated Multi-point"). The number of points available depends on the model, and a full list can be found in appendix C. Multiple flash zones let the camera bias the flash exposure to the currently selected AF point.



7.21 The EOS 5/A2/A2E camera has five focus points and three A-TTL flash metering zones.

7.9.4 E-TTL flash metering patterns

It isn't possible to describe E-TTL flash metering algorithms in much detail since Canon has never published how they work. Metering also varies from model to model and has improved over the years as E-TTL has evolved. For example, EOS cameras with face detection capabilities in their RGB metering sensors (e.g., the EOS-1D X) can also incorporate this information into flash metering.

E-TTL typically uses an evaluative metering pattern for flash, though some cameras allow user selection via a custom function. Some use averaging when in manual focus.

When in autofocus mode, E-TTL cameras bias flash metering toward the currently selected AF point. Most early digital EOS cameras only use evaluative metering for the background when flash is on; never spot or partial metering. When in manual focus mode, some EOS bodies switch to averaging.

Heavy biasing to the active point is potentially problematic, since flash metering ends up almost spot metering. Many E-TTL flash problems appear to be linked to this issue, especially the first digital EOS bodies. If the focus point is over a dark object, for example, flash metering can be considerably overexposed, and vice-versa.

The standard answer to this problem is to use FE lock and meter off something mid-toned, but this is clearly not a great solution for rapid-shooting situations such as weddings and sports. Another approach is to set the lens to manual focus as described above, but that's also awkward.

7.9.5 E-TTL II flash metering patterns

E-TTL II takes a very different approach to flash metering by not biasing the active focus point. Instead, it examines each evaluative metering zone before and after the preflash. It then calculates the weighting for each zone independently, biasing *against* those zones with high reflectivity in the preflash. E-TTL II does not have a flash metering pattern as such, since it's calculated dynamically for each shot. Cameras with E-TTL II should generally have more reliable flash metering than their predecessors.

7.22 Female Japanese jorō-gumo spider, *Nephila clavata*. Fushimi Inari Taisha, Kyoto, Japan. This case would have been a real problem for TTL, with its three or four zone metering system, and E-TTL, which biases heavily to the focus point. The spider occupies a small area of the image but is relatively shiny and reflective. E-TTL II metering does a decent job of lighting the spider without blowing out the highlights. Slow shutter sync was used to expose the background correctly.

7.10 How mechanical camera shutters work

Camera shutters are often thought of as simple panels that slide aside to expose the film or image sensor, and then move back again to end the exposure. This is occasionally the case with point-and-shoot film cameras, but modern SLR shutters are much more complicated.

7.23 The shutter mechanism from a Canon EOS camera.

SLR shutter mechanisms consist of thin overlapping “blades” that slide back into a recess, much like an elevator door. The shutters have two separate doors known as “curtains,” both of which fully cover the film or sensor when closed. Instead of having just a pair of sliding panels, EOS shutters have four or five blades per curtain, made of composite plastic materials or aluminum alloy.

The following is the normal shutter opening sequence, not counting special cases such as silent shooting in digital Live View mode, or when the shutter speed exceeds the camera’s X-sync value.

- To begin, both curtains are closed.
- The “second curtain” (rear curtain in Nikon parlance) opens first. The camera’s computer activates an electromagnetic motor, or release catch, which raises the second curtain blades vertically out of the light path. However, the image area is still covered by the first (front) curtain at this point.
- Next, the first curtain lowers, exposing the image area to light. The shutter stays open for the time period specified by the camera’s shutter speed setting. Normally, this is the point when a flash sync signal is sent to a flash unit.
- When the camera’s computer determines that the correct shutter time has elapsed, it closes the second curtain, blocking the light path. The first curtain stays lowered and open.
- Once the second curtain has closed, the film or sensor is fully covered and exposure comes to an end.
- Finally, the shutter resets itself in preparation for the next shot by raising the first curtain back to its starting position. Once again the film or sensor is completely covered by both shutter curtains.

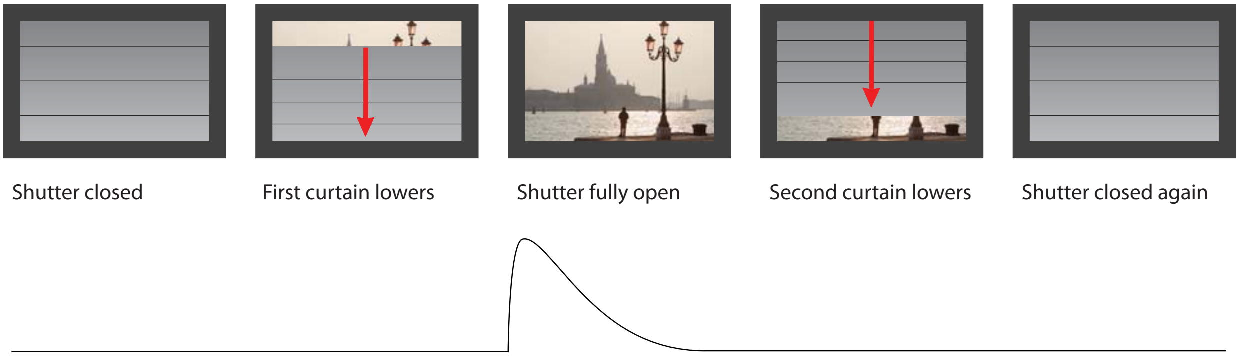
7.24 The black bar on the side of the frame was caused by the camera using a shutter speed that exceeded X-sync

7.11 Maximum X-sync

So what does SLR shutter design have to do with flash photography? Quite a lot, it turns out. At most shutter settings, the shutter blades move so rapidly that the entire image area can be exposed to light with each shot. But mechanical shutters simply can’t move fast enough to allow for really short shutter times, even though the blades may reach a remarkable 20mph/35kph.

The solution for high shutter speeds is to start closing the second curtain *before* the first curtain is fully open. When this happens, the image area is never completely exposed to light. Instead, the curtain motion forms a slit of light that travels across the frame, a bit like a flatbed scanner or photocopier. The speed of the blades never actually changes on most cameras, what varies is the time between one curtain opening and the other closing.

Normal focal plane shutter operation



Single pulse of light from flash unit; synchronized with shutter opening **7.25**

In the case of ambient lighting, where light output remains constant, a moving slit will expose the image evenly and the picture will turn out fine. But with flash photography, the flash pulse is just a brief blink of light. So if the exposed area is a narrow slit at the time, then the whole frame won't be properly exposed. The result of using a higher shutter speed than the camera can handle looks like the example photo. ☐ 7.24

There's one complication for digital cameras: "electronic shutters." An electronic shutter turns the image sensor on and off to simulate a mechanical shutter. Mechanical shutters are still used on most SLRs today because of timing issues with CMOS digital sensors. However, image chips of the future will probably eliminate the need for physical shutters on SLRs, thereby lifting X-sync restrictions. In fact, the EOS 1D, which has a CCD sensor and not a CMOS sensor, has both an electronic shutter and a mechanical one, which is why it has an unusually high X-sync of 1/500 second.

At the time of writing, EOS cameras with Live View can use an electronic first curtain. This means that the sensor is turned on electronically to simulate the shutter opening, but exposures are ended cleanly by relying on the traditional, mechanical second curtain.

> **KEY POINT**
> Cameras with focal plane shutters have a top shutter speed that can be used with normal flash. This is the camera's maximum flash sync, often shortened to "X-sync."

7.11.1 Maximum X-sync limits

Under normal circumstances, you'll never see a picture marred by a dark rectangular flash shadow because the camera won't let you set a shutter speed that's higher than its X-sync. This is why a camera's shutter speed setting may drop when a flash unit is turned on or popped up: the camera is enforcing this internal limit.

Maximum X-sync will vary from as low as 1/90 second on older consumer cameras to 1/250 or 1/300 on professional bodies (and 1/500 for the EOS 1D). Cameras with small image sensors or APS film tend to have higher maximum X-sync speeds than equivalent full-frame/35mm cameras because their smaller shutters operate more quickly.

7.26 Some older film cameras, such as this EOS 5/A2/A2E, have shutter modes marked "X" for electronic X-sync flash.

However, there are three cases where you might find X-sync being exceeded with flash. The first case is non-Speedlite flash units. If a flash unit is triggered via a manual connection (chapter 11), then the camera will have no idea that flash is actually in use. Only automatic, Speedlite-compatible flash units connected to a camera's hotshoe (and, of course, built-in flash) can be sensed by the camera's computer. This makes it easy to get black X-sync bars by mistake when using studio flash.

Sometimes there's a difference between the computer-restricted X-sync value and the actual physical limits of your camera's shutter: Canon engineers tend to be conservative when they program in the maximum X-sync. It's worth testing out different shutter speeds with non-Speedlite flash to make sure.

Canon also specifies a lower X-sync for studio flash units than for Speedlites because most studio units have longer duration flash pulses. Flash units controlled by radio triggers may have an additional transmission delay. The specific timing values of each studio unit vary from one model and configuration to another, so all-manual studio flash (chapter 12) is another area where it's worth doing some tests at different shutter speeds.

The second case where X-sync can be exceeded, high-speed sync, is described in the next section. The third case, PocketWizard HyperSync, is described in section 11.11.8.

7.12 High-speed sync (HSS)/FP (focal plane) flash

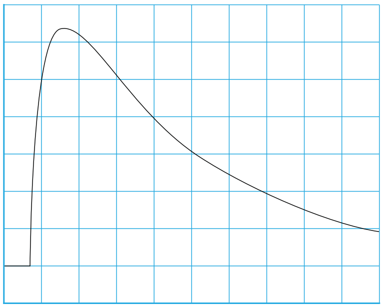
7.27 High-speed sync is marked with the lightning bolt icon and the letter H.

In the 1950s and '60s, many cameras with focal plane shutters could use focal plane (FP) flash bulbs. FP bulbs burned longer than regular bulbs, sustaining their light output long enough to expose a full frame at high shutter speeds. This was a workaround that allowed photographers to shoot at shutter speeds higher than the camera's X-sync.

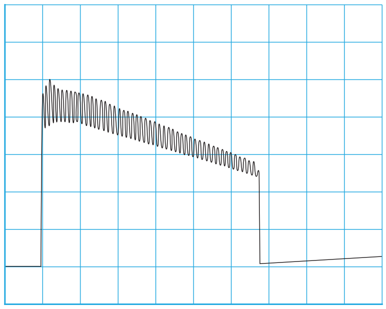
In 1995, Canon added the ability to break an EOS camera's X-sync shutter speed barrier. High-speed sync flash, a technology first implemented by Olympus, lets your camera take flash photos at any shutter speed you want.

In high-speed sync mode, the camera pulses the flash tube at an extremely rapid rate—about 50 KHz. At this speed, the flash tube barely has enough time to decrease in brightness before it's fired again, effectively creating continuous light. However, the pulsed flash has to be produced on a single charge of the capacitor (there isn't time to recharge the capacitor between pulses), and so HSS comes at the cost of reduced total light output. The pulsing of the tube starts slightly before the shutter opens and continues for the duration of the exposure. ☐ 7.29 and 7.30

7.28 The 430EX III RT has graphical icons for the three basic flash synchronization modes – first curtain sync (section 7.13), second curtain sync, and high speed sync. HSS is active here.



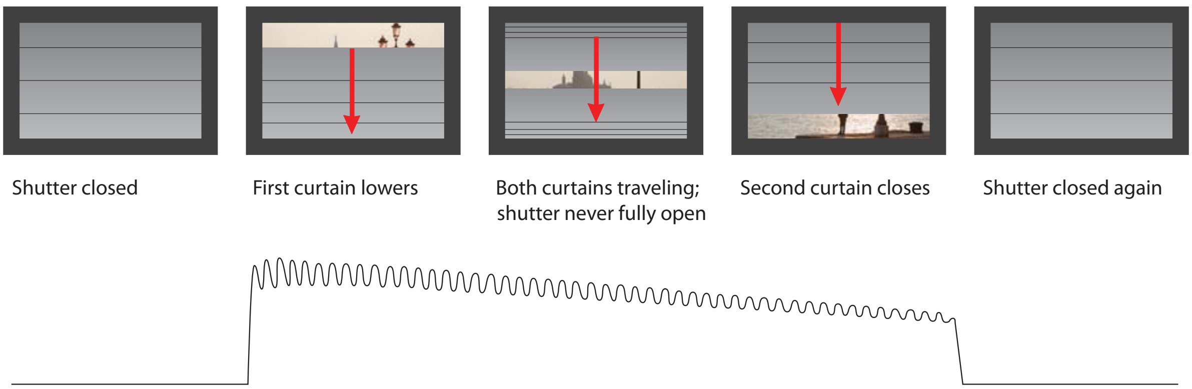
7.29 Normal flash



7.30 High-speed sync flash

Confusingly, this feature is referred to as "FP flash," "FP mode," "high-speed sync," and "hi-speed (shutter sync)" in various places throughout Canon manuals and menus, but these terms all stand for the same thing. In this book, I use the term high-speed sync/HSS because FP flash is an anachronism. FP flash is an analogy to old FP bulbs, though it can also be thought of as "fast pulse" mode, since that's how it works.

High-speed sync shutter operation



Flash unit pulses continuously while shutter curtains travel (pulse frequency not to scale)

7.31

7.12.1 Using high-speed sync mode

High-speed sync (HSS) is useful for shooting with fill flash outdoors using wide lens apertures. It also helps when taking photos in daylight where the flash itself is the primary light source. This is casually referred to as "killing the ambient" (section 15.5).

Normally you can't shoot with fill flash under bright lighting conditions unless the lens is stopped down to a small aperture or unless a very low ISO setting or a slow film is used. However, stopping down the lens increases the depth of field, which is often undesirable for portrait photography where backgrounds should be blurred. Wide apertures let in more light, and increasing the shutter speed means the camera will hit its X-sync limit.

7.32 This photo, taken under the blazing California sun in the early afternoon, clearly shows the difficulty the camera's sensor has in recording the wide range of brightness in the image. The foreground is too dark compared to the background, so the camera just averages everything out. The result is a flat photo with an underexposed foreground. EOS 5D Mark II, 1/125 sec at *f*/7.1, ISO 100, 22mm.

7.33 By using off-camera flash (a 420EX fired by a RadioPopper on a 580EX), the foreground can be lit adequately to drop the exposure to the background, making a more dramatic photo. Admittedly the lighting is a little illogical for those looking carefully (why is the sun coming from two directions?), but generally most people don't notice this sort of thing. The shot employed high-speed sync so that its shutter speed could be high enough to permit a moderately large aperture setting, in order to make the background slightly softened. While this shot used a radio trigger, given the short distance from camera to flash, regular wireless E-TTL could also have been used. EOS 5D Mark II, 1/400 sec at *f*/6.3, ISO 100, 22mm.

HSS solves this problem by letting you choose any shutter speed you want with flash, permitting large apertures to be used under bright conditions. The main drawback is lowered flash output, and thus a decrease in range.

Because HSS doesn't freeze motion in and of itself, the name "high-speed sync" is a bit misleading. "High shutter speed flash sync" would be more accurate. Normal flash photography is very good at freezing motion, since a burst of electronic flash can be incredibly brief. This fact is exploited by certain types of high-speed photography, as described in section 15.9.

However, in HSS mode, the flash unit pulses the light output over a longer period of time in order to produce a longer-duration burst of light. If HSS mode is used with a very brief shutter speed, it may well freeze motion. But

if HSS is used with a lower shutter speed that barely exceeds the camera's X-sync, it may not.

There are different ways of enabling high-speed sync, depending on your camera and flash unit (see section 9.14).

KEY POINT
High-speed sync refers to a camera's ability to synchronize flash exposure with high shutter speeds, not that it always takes high-speed photographs.

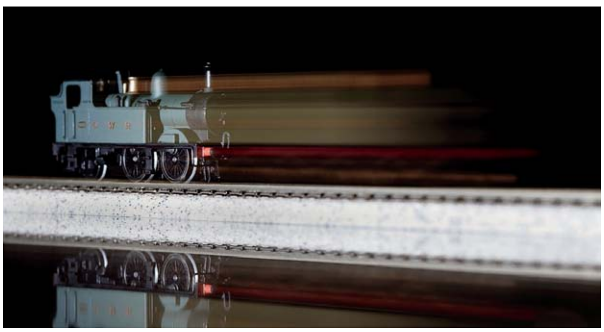
7.13 First and second curtain sync

High-speed sync notwithstanding, a single pulse of light from a flash unit is always much briefer than the shortest shutter time a camera can manage. So a flash could be fired at the beginning, middle, or end of a shot: it wouldn't matter to the final exposure. But, while the exposure wouldn't be affected, the final photo would look noticeably different if moving objects were in the frame.

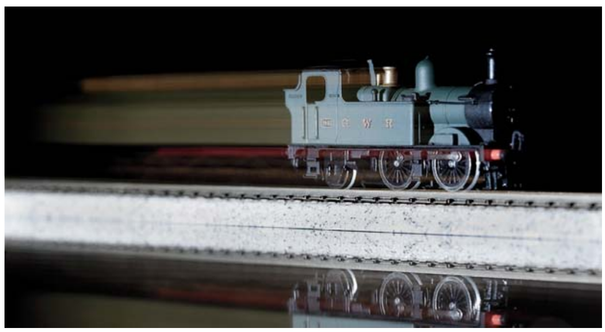
Consider this example. A tiny model steam engine was lit by two light sources, both positioned camera left. One was an ordinary tungsten light bulb in a reflector, and the other was a flash unit equipped with a 1/2 CTO filter (see 7.19.5) to match the color of tungsten light. The model was moving from left to right in each shot, and a long exposure of 0.8 seconds was used each time.

7.34 Shot A: Regular flash sync. Flash only; no ambient light from the tungsten lamp.

7.35 Shot B: Ambient light. No flash; tungsten lamp is the sole light source.



7.36 Shot C: Slow shutter flash sync, first curtain. Both flash and lamp are used. The flash is fired at the start of the exposure.



7.37 Shot D: Slow shutter flash sync, second curtain. Same as C, but the flash is fired just before the end of the exposure.

Shot A was taken with the flash only; the tungsten bulb was switched off. The split-second pulse of light froze the motion of the model, making it appear completely stationary. While this provides a detailed picture, it doesn't convey any sense of movement. ☐ 7.34

In shot B, the light bulb was turned on and the flash was turned off. This photo records the motion of the model down the track, but the result is a smudgy, streak-like blur. ☐ 7.35

To solve the problem, both flash and ambient light can be used together: slow shutter sync. In other words, the flash unit is fired, but it's combined with the same 0.8 sec shutter time in order to provide adequate ambient exposure. This essentially creates a double exposure because two separate light sources with different durations are used.

Unfortunately, this creates an interesting problem, as shown in shot C. The flash fires at the beginning of the exposure as usual, and then the movement of the engine is recorded by the ambient light for 0.8 seconds. The final photo seems to show the engine traveling *backwards* because the flash occurred at the wrong end of the exposure, as it were. This is the problem with first curtain sync, since flash is usually fired immediately after the first curtain opens. ☐ 7.36 and 7.39

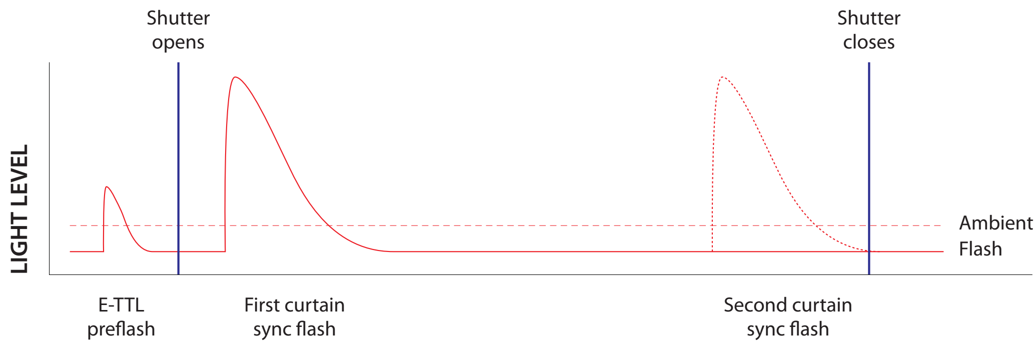
7.38 A 430EX III RT set to second curtain sync mode.

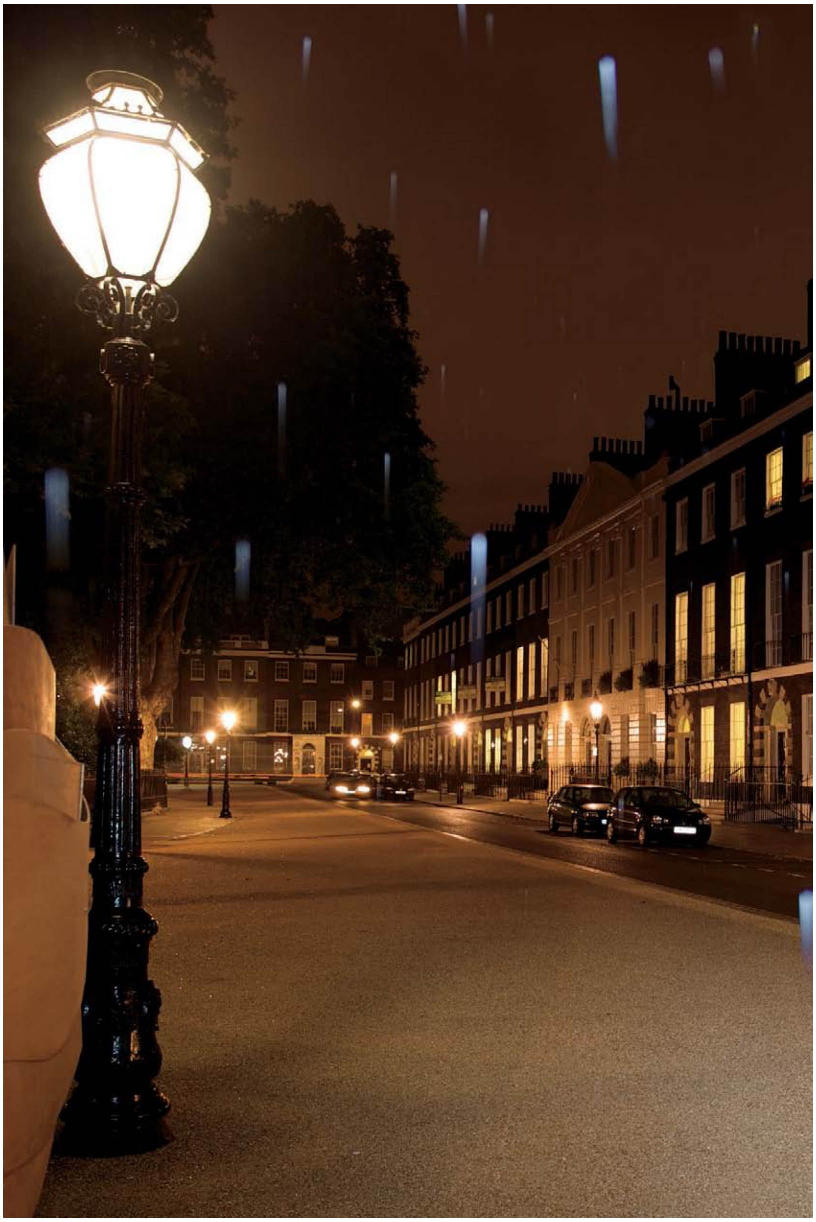
7.13.1 Second curtain sync

The solution to the first curtain sync problem is to wait until the end of the ambient light exposure, and then fire the flash a split second *before* the second curtain closes. This is known as "second curtain" or "rear curtain" sync, and it produces more natural looking results when moving objects are involved. As shown in shot D, the model now looks like it's moving forward since it's illuminated by flash when in its frontmost position. The ambient-exposed smudge looks like a motion trail. ☐ 7.36 and 7.38

Second curtain sync, introduced with the Canon T90 in the 1980s, is available across the EOS line except for some of the first EOS film bodies. Second curtain sync requires a Speedlite flash unit and is not normally available with non-automatic flash units, such as studio flash (chapter 13). Canon identifies second curtain sync with a triple triangle ⧐▶ icon.

7.39





7.40 The first curtain problem can turn up at unexpected moments. Examine this photo, which was taken just as heavy rain was beginning to fall. Note how the raindrops mysteriously appear to be flying upwards. This is because the picture was taken with on-camera flash in first curtain sync mode. The long trails occur because the flash unit was firing at full power, which results in a burst of light followed by a long tail of gradually decreasing output.

7.13.2 Issues with second curtain sync

While useful, second curtain sync isn't always appropriate for photographing moving objects, since it's more difficult to shoot and expose for long exposures. With first curtain sync, it's easy to see an object moving in the viewfinder and trigger the shutter at the precise moment. But with second curtain sync: a) you can't see the moving object when the shutter is open because the mirror will be flipped up; and b) you need to accurately pre-

dict whether or not the object will still be in the frame at the end of the exposure. For these reasons, photographers who do portraiture and the like usually find first curtain sync more appropriate.

EOS cameras default to first curtain sync. For details on enabling second curtain, see section 9.15.

Finally, the E-TTL preflash occurs prior to the shutter opening, and so the flash will visibly fire twice when using long shutter speeds and second curtain. The preflash always fires before the shutter opens; it's just that with a long shutter speed and second curtain sync, the time delay between the two flashes is more apparent.

7.41 For many slow shutter sync shots, the choice of which curtain to sync with doesn't actually matter. The cars on this amusement park ride, for instance, have no obvious fronts or backs for direction of travel, so first curtain sync is fine.

There are two cases in which this delay might be a problem. First, if the subject moves a significant distance, then the preflash metering might be wrong for the final exposure and FE lock may be required. Second, the preflash can confuse human subjects if they're expecting just one flash.

7.14 Inverse square law

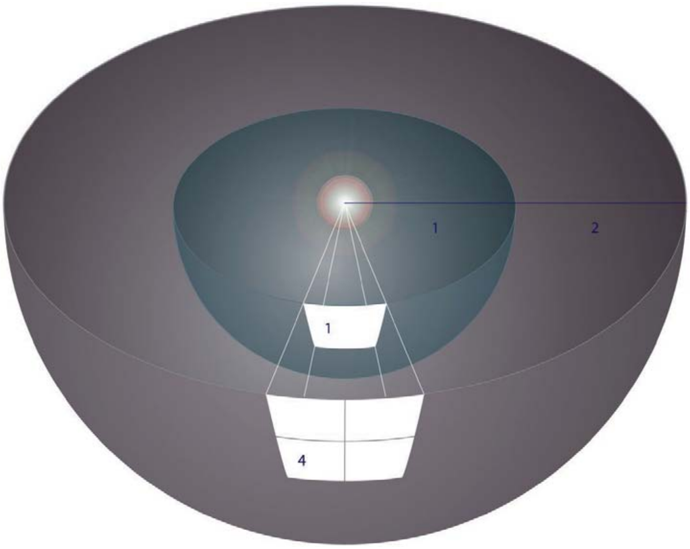
Light drops off from a source surprisingly rapidly. For instance, a campfire is a pool of light surrounded by darkness, and a flashlight shining into the night sky is a bright bar of light that rapidly fades to nothing. You might think that when the distance from a light source doubles, then light is cut by half, but it doesn't work like that—there's actually only a quarter as much light.

Since space is three dimensional, imagine a sphere drawn around a light source that's producing photons. As you get farther away from the light source, this imaginary sphere increases in size. The surface area of the sphere also increases, but it's being illuminated by the same amount of

light. It's not a simple 1:1 relationship; the sphere is not twice as large when you're twice as far from it.

The actual relationship between the distance from the light source and the light output is known mathematically as the "inverse square law." The light output is proportional to the inverse square of the distance.

This sounds more complicated than it really is. If the distance is doubled, the result is $1/2^2$, or one quarter as much light. If the distance is quadrupled, the result is $1/4^2$, or one sixteenth as much light. Notice how the light decreases quite quickly. ☐ 7.42



7.42 Consider two nested spheres with a light source at the very center. At a distance of one unit from the source, the light covers an area of one square. But at two units from the source, the light has spread out to cover an area of four squares.

All ordinary light sources (lasers are one exception) follow this rule, which is why light from a flash unit drops off pretty fast. The implications of this rule are even worse for flash photography because the light has to travel from the flash unit to the subject and back to the camera.

Add the fact that much of the light is absorbed by the subject and not reflected, and it's a wonder that flash units work at all. This is why very little flash range is gained by moving to a slightly bigger flash unit, and why foreground objects are much more brightly lit by a camera-mounted flash unit than distant objects. ☐ 7.43

In short, the limits imposed by the inverse square law explain the differences in lighting between foreground and background in a typical flash-illuminated photograph. A flash unit needs four times the power output in order to throw light twice as far.

KEY POINT
Light decreases very rapidly with increased distance from its source, in accordance with the inverse square law. This is why it's easier to illuminate a nearby object with flash than an object slightly farther away.

7.43 Light is projected along a wall and reflected off the model's face. Note how rapidly the light falls off in brightness, especially the pinkish light reflected off her face, which also isn't as sharply focused as the bluer light from the flash unit.

7.15 Guide numbers

The maximum distance range of a portable flash unit is often described by its guide number (GN). Users of automatic flash metering may never deal with guide numbers at all, but they can be used to calculate the aperture required to illuminate a subject at a certain distance, or vice-versa. The GN describes the distance coverage of a flash unit, *not* its power output, which is important when comparing different flash units.

To find the aperture (*f*-stop number) required, divide the unit's guide number by the distance to the subject. To find the maximum distance that can be reasonably illuminated using the current aperture, divide the GN number by the *f*-stop. In each case, the distance from the flash unit to the subject is important, not the distance from the camera to the subject. These two distances may be the same with on-camera flash, but not with off-camera flash or with bounce flash.

f-stop number = GN/distance
distance = GN/*f*-stop number

A guide number is only useful if the distance units and the sensitivity of the film or sensor are known. Canon provides guide numbers in meters for ISO 100. The Speedlite product names, such as 600EX, include the highest metric guide number of the flash unit (the guide number on maximum zoom in the case of zooming flash units) multiplied by 10.

Older Canon USA literature uses guide numbers in feet, though newer documents list both feet and meters. The former can be confusing: a flash unit of GN 43 sounds great, but not if it's actually a metric GN 13. Only metric

guide numbers are used in this book to be consistent with the Speedlite naming system. To convert to a GN in feet, simply multiply the metric GN by 3.

7.44 Old flash units, like this Vivitar 285 from the 1970s, sometimes had a daunting calculator on the side. You could dial in the film speed in ISO, the lens aperture as an *f*-stop number, and the distance in feet or meters. It would then tell you a color-coded power output setting. Canon Ext.M autoflash mode does something similar today.

Remember that the GN takes film/sensor sensitivity into account, since flash range increases with ISO. So if an ISO/film speed other than ISO 100 is used, that must be factored in. The math is based on the inverse square law: quadruple the ISO to double the guide number. Here's a quick conversion method that avoids square roots:

ISO doubles: GN × 1.4
ISO halves: GN × 0.7

Another critical point when comparing flash units is that zooming flash heads affect the GN. For example, two units may have identical power circuits and flash tubes, but one has a zooming head that goes to 105mm whereas the other goes to 80mm. The former unit will have a higher maximum guide number, since it can concentrate its beam of light farther. Studio units with interchangeable reflectors have similar issues.

Finally, a fair bit of subjectivity goes into determining the guide number. After all, how is an "adequately exposed" subject determined? Guide numbers are not a reliable way to compare flash units built by different manufacturers. Companies tend to be somewhat optimistic when it comes to assigning guide numbers to their products.

7.16 Quantifying flash output

One challenging aspect of comparing flash products from different companies is that each firm measures output differently. There's no one standard, so it's virtually impossible to know whether one company's flash unit puts out more light than another's without performing empirical tests with a meter.

A fundamental problem is that each company measures a different thing. They're not necessarily being dishonest; measuring light is a complicated subject. Consider ordinary household lighting. Years ago, when tungsten bulbs were the only household electric light source available, people got into the habit of referring to the brightness of a bulb by its wattage. Everyone knew how much light a 60-watt bulb produced. Unfortunately, wattage refers to the electricity *consumed* by the bulb, not the amount of light *produced* by it. So this simple system fell apart when fluorescent bulbs and LEDs arrived on the scene. All of a sudden there were more efficient bulbs that produced the same amount of light but at a lower wattage.

The other major issue involves area and distance. Think of a regular bulb in a ceiling fixture. It spreads light evenly and gently around the room. But what if the same bulb were in a desk lamp? All of a sudden its light would seem very intense and narrowed down. The same amount of light is produced; it's just more concentrated by the lamp's reflector.

These two issues affect measuring systems used by flash units as well, with the added complication that flash involves brief pulses of light, not continuous streams.

7.16.1 Watt-seconds (Joules)

The two terms are synonymous, and they are a measure of the amount of energy produced by a device's electrical system; they are not an indication of light output. This is a common measurement, but unfortunately not always a useful one. A highly efficient electronic design may consume fewer Joules than a badly designed one, yet put out as much light.

7.16.2 Effective watt-seconds

A marketing variant on watt-seconds. A manufacturer may claim that its flash units are more efficient than another's and thus produce as many "*effective* watt-seconds" as their competitor's products. Nobody really knows what this means: it's very effective confusing advertising!

7.16.3 Guide number

A measurement of flash coverage described above. The key point is that the guide number is highly dependent on the coverage of the flash head, not just the light output of the flash tube. This measurement also takes film sensitivity/ISO into account.

7.16.4 Lumen-seconds

A metric measurement of the amount of light (the "luminous flux"), weighted to the sensitivity of the human eye, produced by a light source for a period of one second. Unfortunately, discussions of lumens veer off rapidly into the arcane provinces of physicists and engineers. (The official definition of the lumen involves concepts such as solid angles of steradians and single-frequency 540 terahertz lights.) Nonetheless, it is a proper and honest way of evaluating the amount of light produced by a device, though not one commonly used by flash unit manufacturers.

7.16.5 Beam candlepower seconds (BCPS)

A measurement of the intensity of a light source, taking the qualities of a reflector or a lens into account (i.e., the "beam").

7.17 Exposure value (EV)

The sensitivity of camera gear at autofocusing or determining correct exposure metering is rated in terms of EV—exposure value—for a given lens type and film speed or digital ISO.

Since the amount of light hitting the film or sensor is determined by exposure time (shutter speed) and lens aperture, EVs are simply combinations of shutter speeds and apertures that produce the same exposures. For example:

f/4 at 1/30 sec has an EV of 9
f/2 at 1/125 sec has an EV of 9

Both of these speed/aperture combinations let the same amount of light hit the film or sensor; the only differences between the two are depth of field and type of motion recorded. Depth of field decreases as the aperture increases, and subject motion blur increases as shutter speed decreases.

However, it's only meaningful to compare exposure values if they're rated for the same film speed or ISO. Canon rates EV values in its documentation for a standard 50mm f1.4 lens using ISO 100.

Table 7.1: Exposure value (EV) table at ISO 100

	f/1	*f*/1.4	*f*/2	*f*/2.8	*f*/4	*f*/5.6	*f*/8	*f*/11	*f*/16	*f*/22	*f*/32
1"	0	1	2	3	4	5	6	7	8	9	10
1/2	1	2	3	4	5	6	7	8	9	10	11
1/4	2	3	4	5	6	7	8	9	10	11	12
1/8	3	4	5	6	7	8	9	10	11	12	13
1/15	4	5	6	7	8	9	10	11	12	13	14
1/30	5	6	7	8	9	10	11	12	13	14	15
1/60	6	7	8	9	10	11	12	13	14	15	16
1/125	7	8	9	10	11	12	13	14	15	16	17
1/250	8	9	10	11	12	13	14	15	16	17	18
1/500	9	10	11	12	13	14	15	16	17	18	19
1/1000	10	11	12	13	14	15	16	17	18	19	20
1/2000	11	12	13	14	15	16	17	18	19	20	21
1/4000	12	13	14	15	16	17	18	19	20	21	22

The vertical axis shows shutter speed (Tv or time value) in seconds. The horizontal axis shows the lens aperture (Av or aperture value) in f-stops. EV tables makes it easy to work out specific combinations of shutter speed and aperture for different light levels. They were popular decades ago, before automatic light meters were built into each camera. EV tables are still used today by night photographers. Note that this particular table is for ISO 100 only. For other ISO values you'll need to increase the EV by 1 for each doubling of the ISO. Thus EV 9 at ISO 100 would be EV 10 at ISO 200 and EV 11 at ISO 400.

7.18 Color and shades of white

When it comes to interpreting color, our eyes (or, more accurately, our brains) are extremely adaptable. A sheet of white paper in a room lit by an incandescent tungsten bulb will look pure white. The same sheet of paper carried outdoors and examined in sunlight will still look white. But to a machine, the light reflected off the paper will look completely different. Tungsten bulbs and the sun produce different colors of light: tungsten light is fairly orange whereas sunlight is relatively blue.

Normally, our visual systems compensate for these differences in color temperature automatically. One of the few times they become really noticeable is when encountering different types of light at dusk.

Take the classic scene at right. The incandescent light spilling from the windows of the old mill looks quite orange-yellow in tone compared to the blue of the evening sky.

In colloquial English, we say that yellowish or reddish light is "warmer" than bluish light. Yet according to a physicist or a photographer, bluer light has a *higher color temperature* than reddish light. Why is this, and what does this mean?

7.45 Cropthorne Mill on the River Avon. Near Evesham, Worcestershire, England.

7.18.1 Color temperature

Color temperature is a scientific model that explains certain aspects of the concept of "white." Imagine a plain iron bar. At room temperature, it may appear almost black. But, when heated, it will start to glow with a dull red light. As it gets heated further, the light becomes yellow and eventually white as it melts.

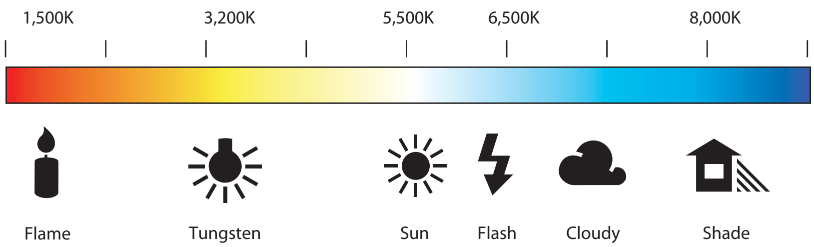
This is the basis of color temperature. Instead of a lump of iron, the model relies on a theoretical notion: a "black body," or an imaginary substance that absorbs all light and is, therefore, black to the eye. As it's heated, this black body will start to radiate energy that we can see as light. The color of the light is described in terms of the temperature required to create it, measured in Kelvin units. (Kelvin is similar to the Celsius scale but uses absolute zero, –273.15°C, as the starting point rather than the freezing temperature of water.)

Regular incandescent light has a theoretical color temperature of about 3200 Kelvin, though this varies and household bulbs often produce about 2900K. They also drop in color temperature as they age or when put on a dimmer circuit. Tungsten halogen bulbs (usually just called "halogens") and non-daylight-corrected photoflood bulbs are usually slightly higher, sometimes reaching 3400K. The light from a candle flame is quite low in temperature, hovering around 1400–2000K.

7.46 This photo is lit primarily by candles, which lend a characteristic reddish-orange glow. A tungsten light bulb was used to fill in the shadows, since its yellow light blends quite well. Edward Saperia demonstrates Cryptofloricon.com, his online messaging service that sends encoded communiqués through flowers.

Daylight is between 5000K and 6000K, often given as 5500K for the temperate midday sun. Naturally these values can differ depending on time of the day, latitudes and altitudes, and weather conditions. In fact, natural light can vary from around 2000K at sunset to over 20,000K in blue evening shade. Skylight, or the sun's light scattered by the atmosphere, is extremely blue in color. ☐ 7.47

7.47



It's important to remember that the Kelvin color temperature value doesn't necessarily refer to the actual physical temperature of an object. This description of color temperature is also a vast oversimplification of physical theory, but one that's useful to us as photographers.

KEY POINT
You can think of color temperature as a way of quantifying, or conveniently labeling, shades of white on a linear orange to blue spectrum.

7.48 This available light photo, taken at the Alhambra in Granada, Spain, shows the tremendous difference between the tungsten-lit interior (most of the image) and the daylight shining in from outside (the seemingly blue arch). The stonework is all the same color, but it's lit by light sources with different color temperatures.

7.18.2 Color temperature and film

Color temperature isn't some academic issue. It's a real issue when shooting with color film because film records light using chemical processes and can't adapt to changing light conditions. Film is formulated in the factory to assume a certain color temperature is white.

This is what is meant by "daylight" film and "tungsten" film—they're film types designed to assume that daylight and regular tungsten light bulbs, respectively, are white. Color shifts will occur if the wrong type of film is used. A tungsten-lit room shot on daylight film will look quite orange, and a daylight-lit room shot on tungsten film will look quite blue. So it's important to use film that matches the lighting conditions, or use appropriate filters. ☐ 7.48

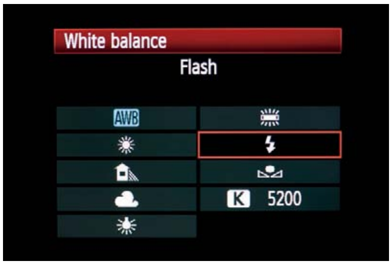
However, there are very few film emulsions still available that are tungsten-balanced, and most are very slow. If you need a high-speed film for tungsten lighting (e.g., you're shooting in a dark theater), then you either have to use color-correcting filters or shoot digital. ☐ 7.49

7.49

7.18.3 Color temperature and digital

Color temperature is more of an opportunity than a problem in the world of digital. Digital cameras record color as a bunch of numbers in a computer, rather than on a physical material with complex chemical interactions. So it's pretty easy for a digital camera to assume different colors are the correct white point. This can easily be used to creatively alter, as well as simply correct, mismatches in lighting color.

Digital white balance (WB) offers a number of choices. A camera can operate in automatic mode (AWB), or you can specify different preset or custom white balance settings as required. In AWB mode, the camera examines the recorded scene and decides the dominant color cast, at least between 3000K and 7000K. (Two early EOS digitals, the 1D and the 1Ds, also used an external white balance sensor.) Preset color balance settings make certain assumptions about color conditions, such as daylight, flash, cloudy skies, and so on. And custom white balance settings allow you to take a picture of a white object lit by ambient light so that the camera can measure white balance against that.



7.50 White balance settings

7.51

Icon	White balance type	Approximate temperature
AWB	Automatic	3000K–7000K
	Temperate daylight	5200K
	Shade	7000K
	Cloudy/twilight	6000K
	Tungsten bulb	3200K
	White fluorescent	4000K
	Flash	6000K
	Custom (user set)	2000K–10,000K
K	Kelvin units	2500K–10,000K

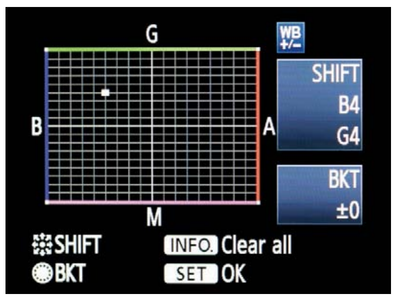
EOS digital bodies with a "flash" white balance setting assume a color temperature of 6000K in order to match the light from common studio flash units. However, Speedlite flash units are closer to a daylight color temperature (at 5500K or so), so a photo lit with a Speedlite and the flash white balance setting can end up being a little off. Automatic white balance

(AWB) or daylight white balance might be better options. Alternatively, a custom white balance setting can be used, especially user-defined custom white balance.

7.52 This photo shows how a camera's automatic white balance system can have problems. The camera assumed that the orange glow from the "squirrel cage" tungsten light bulb is the dominant light source and balanced for that accordingly. The bulb, driven at half power, is producing very orange light compared to the two Elinchrom D-Lite studio units (equipped with narrow striplights to get the striped effect on the bulb) actually lighting the scene. The final result is that the white balance of the model's face is far too blue.

7.53 This version was manually white balanced to restore the proper warm color to the model's face. This also heightened the orange of the bulb's filaments, but that isn't really a problem for this shot. EOS 5D Mark II, 1/10 sec at f/5.6, ISO 50, 100mm.

Finally, digital white balance is actually more complex than this. Instead of simply representing color on a single yellow-blue axis, white balance also uses a magenta-green axis. The color temperature scale is just the one we encounter in everyday life more regularly, owing to the way common light sources work. 7.54



7.54

7.19 Color filters

The light from a portable flash unit is pretty close to direct noonday sun in a temperate latitude: around 5500K to 5600K, or a slightly bluish-white light. But this type of simulated daylight isn't going to be the right white for every photograph. Daylight may be too warm or cool, and it may clash with existing light. Or perhaps a dramatic color, such as a rich red or dark blue, is needed for a special effect. This is one area where color filters come in.

White light consists of colors of various wavelengths across the whole color spectrum, as Newton discovered with his famous prism experiments. Our brains interpret this sensation of light energy as something we call "white." Since white light is made up of so many wavelengths of energy, it's easy to put some material in front of a light source that will block or absorb certain frequencies. Our brains then interpret the remaining wavelengths of light as a different, non-white color.

Color filters for light sources typically serve one of two purposes. First, they are commonly used for color correction, which usually means altering the color temperature of white light for color matching. Second, they are used to produce specific strong colors for special effects.

7.55 The 1980s called, and they want their filters back. This shot was backlit by an unfiltered Bowens Gemini monolight, with the foreground fill by a 580EX II in manual mode, zoomed to 105mm and filtered with a red gel.

Filters can be put in different places. To change the color of an entire scene, a filter can, of course, be placed over the lens. To affect the output of a specific lamp, a flexible gel filter can be put over that specific light. A filter or colored diffuser can be put over a flash unit's head to affect just the light it produces.

7.19.1 Color temperature correction

Since the light from a flash unit is a neutral to bluish white, it can easily be tinted. It might be necessary to balance the light from a flash unit to match ambient lighting conditions. The most common need is found indoors where you often need a flash unit to match the yellowish light from a tungsten light bulb. Another common use is to "warm up" a flash to more closely match sunshine at dawn or sunset. If filters aren't used in cases like this you can get the colors of different areas in a photo clashing unnaturally.

The converse can also be true. Maybe you want flash-lit areas to be a dramatically different in color from the ambient lighting for creative effect.

7.56 The lower right side of this photo is poorly lit and quite dark. This is a shame, since it's the original Roman section of the Roman baths in Bath, England. The Victorian reconstruction is well lit with artificial lighting. Fill flash can help in this regard, but light from a normal flash would be too blue in color.

7.57 This shot has some fill from a Speedlite 580EX II. A warming filter was used so that the light from the flash unit would approximate the orange-yellow artificial lighting.

Color temperature conversion can go in one of two ways. To go from yellow-orange light (tungsten) to blue light (daylight), a “cooling” or blue filter is required. To go the other way, a “warming” or yellow-amber filter is needed. As noted earlier, these names are somewhat confusing since cooling involves an increase in color temperature and vice-versa. The names reflect ordinary casual usage of the words and not color temperature theory.

7.19.2 Non-tungsten artificial lighting

Color casts also occur from other forms of artificial lighting. The light from fluorescent tubes can often veer off into a nasty green. Full-spectrum fluorescent bulbs have a slightly more pleasing color balance, though they don’t quite match incandescent lights. The color output of fluorescents tends to “spike,” or produce slightly more intense colors in narrow bands. This is one reason fluorescent light, even from compact fluorescents designed to simulate tungsten, can look unnatural.

To minimize fluorescent color casts, many news photographers carry pale green filters. These help flash units to more closely match the unhealthy greenish glow of an office. When shooting digital, the camera is then set to fluorescent white balance, and the result should be more consistent color in the final photo.

More problematic are the high-pressure mercury lamps used for industrial/public space lighting and the yellow sodium lamps used for streetlights. These gas-discharge sources produce light in very narrow bands, resulting in unpredictable color casts that depend on the formulation of the bulbs. Complicating matters is that such discontinuous light sources don’t glow but flash on and off 50 or 60 times per second. This imperceptible pulsing is why photos taken with short shutter speeds may have inconsistent exposure or color if the picture happens to be taken at a low point or high point of the lamp’s power cycle. ☐ 7.58

Technically speaking, the term “color temperature” shouldn’t be used for fluorescent and gas-discharge lights, since they don’t have incandescent filaments. However, approximate equivalent color temperature numbers (correlated color temperature values) are often supplied by manufacturers as a convenience.

7.58 Like many public spaces, the Piazza San Marco in Venice is lit by high-efficiency, gas-discharge lights. Building interiors are lit by tungsten and fluorescent sources. These artificial lights look very yellow and orange against the blue twilight sky.

7.19.3 Mixed light sources

Shooting in mixed lighting conditions can be very challenging without some filtration. The colors in the final photo will be all over the map, and it can be difficult or impossible to fix digitally after the fact. Color correction filters to modify the light output of a flash can tame more extreme color differences.

Short of switching to black and white, the easiest way of dealing with mixed lighting sources is to gel any lights under your control to match the dominant ambient light. You can never get every light source to match precisely; the goal should be to minimize gross or obtrusive color differences. For example, a room lit with tungsten light would clash with unfiltered fill flash. The simple addition of a half-strength yellow (1/2 CTO: see 7.19.5) filter on the flash head could be enough to bring the fill close enough in line to the ambient artificial light (full CTO filters can be too yellow). 7.59

With that in mind, there's still something to be said for emphasizing various color sources. Take the photo that opens this chapter, for example. Lyle Rowell's LRRY, a walking kinetic sculpture powered by a car engine, was lit by three basic light sources. The first was a snooted studio flash unit to camera left for fill. Directly behind the sculpture, illuminating the smoke with bluish-white flash, was a high-powered studio unit. And the intense

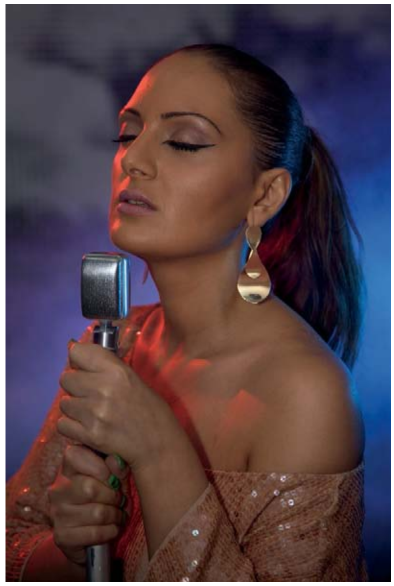
light from the propane flames bathed the front of the sculpture in yellow light. The different colors of light created a far more interesting and layered shot than if all the light sources had been the same color.

7.59 This photo is lit by two light sources. One is an AlienBees B1600 flash unit, powered by a generator, located camera right. The other is the stream of flame itself. The result is two different shadows of two different colors. This shot was adjusted digitally to make the flash-illuminated areas slightly warmer, but this resulted in a rather orange patch of ground lit by the flame.

7.60 Speedlite 600EX/600EX-RT units ship with clip-on filter holders and CTO filters.

7.19.4 Special effect filters

Filters are available in almost every color imaginable, from subtle to lurid. Simply by installing a filter over a light, a white backdrop can be changed to blue or green. A red filter can simulate neon lighting coming through the window of a motel room. But note that filters have to be darker (i.e., more saturated) than one might expect to achieve rich colors, particularly with bright flash units and other high-powered light sources. A red-filtered light might end up looking rather pinkish in the final photo. □ 7.61



7.61 This picture was taken using three Speedlites. A 580EX on-camera was used for white light fill and as an E-TTL master. A 580EX II was on a tall light stand, camera left, and filtered red. A 430EX II was on a lower light stand, camera right, and filtered.

7.19.5 Filter naming

Filters used for changing the color of light sources all have manufacturer-specific codes or names. However, gels for color temperature conversions are often described as "color temperature orange/CTO" or "color temperature blue/CTB" depending on whether they're warming or cooling filters. Less saturated versions of these filters are usually named in fractions, such as 1/2 CTO or 1/4 CTB. Stacking a pair of 1/2 CTO filters will yield the same color as a single full CTO, for example.

Note that a CTO from one maker will not have precisely the same color as a CTO from another—there are always slight differences. A CTO variant that a lot of photographers find useful is "color temperature straw/CTS," which has similar color temperature shifting properties to CTO but with a less reddish tone.

Table 7.2: Yellow-orange "warming" filters

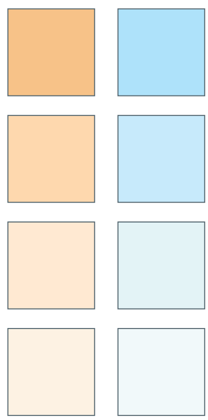
Full CTO	5500K–2900K
3/4 CTO	5500K–3200K
1/2 CTO	5500K–3800K
1/4 CTO	5500K–4500K
1/8 CTO	5500K–4900K

Table 7.3: Blue "cooling" filters

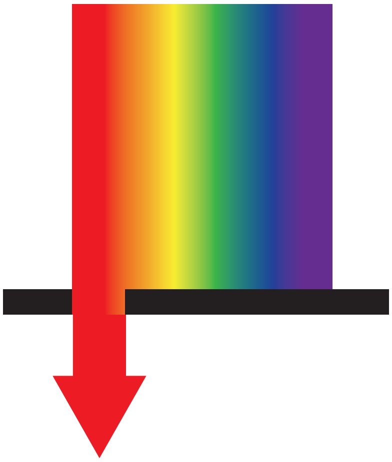
Full CTB	3200K–5500K
1/2 CTB	3200K–4100K
1/4 CTB	3200K–3500K
1/8 CTB	3200K–3300K

Some manufacturers of lens filters use the Wratten series of numbers. More than a century ago, British inventor Frederick Wratten developed a fairly arbitrarily numbered series of color filters. Kodak bought Wratten's company in 1912, though Wratten-branded filters are now sold by Tiffen. Orange-colored Wratten filters are in the 85 series, and blue-colored Wratten filters are in the 80 series. German manufacturers use a different system in which KB is a cooling (blue) filter and KR is a warming (orange) filter.

Filters for special effects do not have any sort of standardized names. They tend to have cheesy names like paint colors, of the "moonlight blue," "neon carrot," and "exploded strawberry pink" variety.



7.62 Some common filter colors. The colors are full, 1/2, 1/4, and 1/8 CTO (left) and CTB (right).



7.63 This diagram shows how a filter blocks (absorbs) light of certain colors. In this exaggerated example, white light consisting of every visible wavelength is shone onto a filter. The filter blocks the passage of blue and green wavelengths of light, allowing only reds to pass through. The filter can't transform blue light into red light or anything like that.

7.19.6 Limitations of filters

One important thing to remember about filters is that they cannot shift colors along the spectrum, per se. All a filter does is simply prevent certain wavelengths of light from passing through by absorbing them. So, by definition, color-correction filters always *reduce* the amount of light entering the camera or produced by a light source. Blue or red filters in particular can easily cost you a stop of light.

As discussed above, filters change the color of white light by removing certain wavelengths, so filtering a flash head or tungsten bulb works well. But if a scene is illuminated by, say, pure red light, then it isn't possible to apply any sort of filter on a lens to make things a different color. Filters can't add light of any wavelengths or convert incoming light to a different wavelength.

This is why filters are fairly useless when you've got light sources such as yellow-orange sodium streetlights, neon signs, mercury vapor gymnasium/industrial lighting, or color LEDs. These lamps produce light of very narrow spectral bands, so filtering out the dominant color doesn't leave much else.

The limits of filtration really hit film users when it comes to color correction. There are ways of altering colors in the darkroom, but they're expensive and cumbersome. By contrast, color mismatches are a mere inconvenience for digital users. The only complication is when numerous light sources of different colors illuminate a scene, because different colored patches of light will show in the final image.

7.20 Infrared (IR)

7.64 The LED on an IR remote control is invisible to the human eye, but is clearly recorded by a camera that's capable of seeing into the infrared.

From a non-technical perspective, infrared (IR) can be thought of as invisible light used by devices such as TV remote controls and night vision cameras. From a technical perspective, IR refers to a band of electromagnetic radiation that is just outside the range of human visual perception. The word stems from the Latin "infra," for "below"; in this case, the light is below the red section of the light spectrum in terms of frequency.

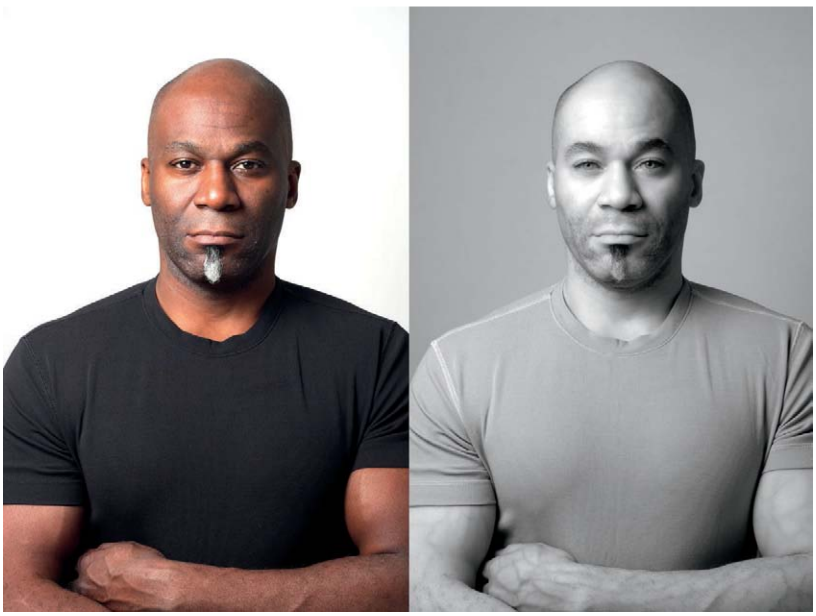
Contrary to popular misconception, IR-sensitive cameras don't record heat: they aren't thermal imagers. Infrared photography records *reflected* IR from an IR source such as the sun. Ordinary xenon flash tubes are also an excellent source of IR, and cameras or film capable of sensing IR can easily be used with flash. This fact can be exploited for flash photography in which the subjects can't see the flash.

For example, 1940s American news photographer Weegee (Arthur Fellig) sneakily took a series of famously voyeuristic photographs of people watching movies and making out in theaters. They were shot using infrared-sensitive film and a flash filtered to pass IR and block visible light, so that the subjects didn't know they had been photographed. The ethics of this type of photography are perhaps best discussed elsewhere.

7.65 Digital Voyeurvision! This picture was taken in near-complete darkness. The scene was lit by an on-camera flash unit with infrared filtration, and the camera was a digital EOS 10D modified to record IR but not visible light.

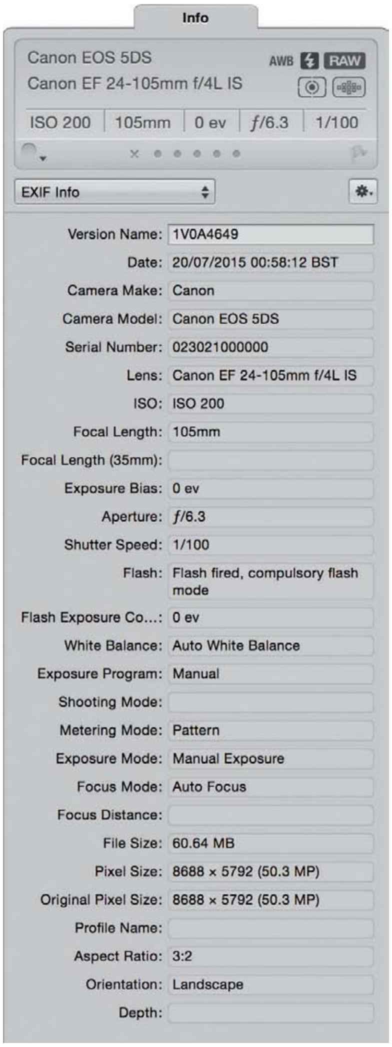
True infrared-sensitive film is available from professional suppliers, and most digital cameras have IR-blocking filters installed over their image sensors. However, many digital cameras can be modified by removing these filters, making them sensitive to a range of IR energy.

Flash tubes also produce ultraviolet (UV) energy at the other end of the spectrum. This is much more difficult to use photographically, however, since it requires lenses manufactured from crystal or special UV-passing glass. In addition, most flash units have treated glass to reduce their UV output, since UV adversely affects visible-light photography. Some Pyrex domes (section 13.2.1) are also coated to block UV.



7.66 The mysterious world of infrared portraiture. The left-hand photo was taken with a EOS 5D, which records ordinary visible light. The right-hand photo was taken with a modified 10D that had a light-blocking IR-passing filter over the lens. In both shots, a single Elinchrom D-Lite 4 monolight was used.

Note how light-absorbing areas of the photo, such as dark brown irises and black synthetic fabric, actually tend to reflect infrared. Skin takes on a strange alabaster-like look, and veins suddenly become quite visible, a characteristic helpful to medical researchers and forensics investigators.



7.67

7.68 Like a Japanese manga comic, the 600EX will show this steaming icon if it overheats.

7.21 EXIF and flash data

One of the great hidden benefits of digital cameras, from a learning perspective, is that they automatically label each photo with shooting data in EXIF (Exchangeable Image File) format. This makes it easy to go back after a shoot and see exactly what shutter speed, aperture, focal length, etc. was used. This is far more convenient than jotting down information in a notebook while shooting photos.

Some flash-related data is stored as well. EOS cameras record where flash is fired or not, whether flash exposure compensation is applied, what the FEC value is, and whether redeye reduction is enabled. Note that this data is stored only if a fully automatic Speedlite flash unit (or popup flash) is used: the camera has no way of knowing if a manual external flash unit is fired. Unfortunately, wireless E-TTL settings are not recorded in EXIF.

To view EXIF information, open an image using Canon's Digital Photo Professional software, or any other photo-editing application such as Adobe Photoshop that can display EXIF metadata. ☐ 7.67

7.22 Safety and physical properties

7.22.1 Overheating and fire hazards

A flash unit generates a surprising amount of heat when fired. Even a battery-powered flash unit can burn you if the flash head is held to your skin. Normally the heat dissipates rapidly, since the flash burst is so brief. But in a rapid-fire situation, the heat can accumulate quite quickly, risking damage to the flash tube, its clear plastic cover, or anything touching it. A flash tube can actually scorch or ignite cloth or paper.

Heavily used older battery flash units often have a yellow or orange patch in the middle of the plastic flash lens. This occurs when using high-powered flashes repeatedly (e.g., wedding photography) or when using high-speed sync or modeling flash for extended periods. Filters or other accessories over the flash head can increase the risk of overheating as well.

To minimize the risk of damage, many flash units from Nikon SB900s to Elinchrom D-Lites contain temperature sensors that shut off the unit if it becomes too hot. The unit must then be left to cool down. The Speedlite 580EX II has such a temperature sensor and also counts the number of shots fired within a specific time frame. It then forces an increased wait time between firings, though there's no way to override this. The 600EX/600EX-RT's display will switch to a bright red backlight to warn you if it's overheating. Some EOS cameras with built-in flash units also restrict firings for safety reasons. If a camera displays the message BUSY and refuses to fire the flash unit for a few seconds, this is why.

Because it's incredibly annoying when a flash unit simply goes on strike like this for some period of time, it's worth testing the heat sensitivity of your gear before doing an important shoot.

Another significant fire risk is posed by the incandescent bulbs used as modeling lights in AC-powered studio gear. These can start a fire in moments if they touch fabric or plastic, such as a softbox or other diffuser. ☐ 7.69

Some high-powered studio units have optional glass domes (section 13.2.1) that can be installed over the flash tube and modeling lamp to protect both.

7.69 The risk of fire is not hypothetical. This high wattage bulb touched the side of a light diffuser for a few seconds with incendiary results.

7.22.2 Flash safety and babies

A common concern is whether flash photography can damage the sensitive eyes of babies and infants. I put the question to the Pediatric Service of the Moorfields Eye Hospital in London, and they confirmed that they were not aware of any serious dangers from occasional use of flash at normal distances from the eye.

Having said that, this is obviously not a free license to blast a poor baby with flash. At the very least, the baby is probably going to find it an unpleasant experience. This also doesn't apply to firing a flash close to a baby's face (which is something that should never be done to anybody) and which sometimes happens because babies are so small and a common tendency is to put the camera close to them.

In short, taking the odd flash photo in a room that happens to have a baby in it is unlikely to cause any problems for the baby's vision. But enforcing flash safety measures is a good way to keep Uncle Bob from sticking his flash-equipped point-and-shoot into the baby's face. And frankly, baby photos are probably going to benefit from soft natural light rather than harsh on-camera flash anyway.

7.70 This photo of a baby's delicate eyes was taken with daylight fill flash. To reduce any possible discomfort, the flash was positioned some distance from the baby, and shone into a Rogue Flash-Bender reflector, rather than being aimed directly at the baby's face.

7.22.3 Shock hazards

Electronic flash technology involves extremely high voltages—literally hundreds of volts. The internal components of any flash unit maintain a high-voltage kick *even when the device is turned off*. It takes quite a while for this high-voltage energy to drain out of a flash unit's capacitors. Even cheap disposable cameras with built-in flash units can produce severe shocks if they're disassembled.

For this reason, it's very important that an electronic flash unit, whether powered by small batteries or AC power, *never* be opened up except by an experienced technician ☐ 7.71. The capacitors might literally give a nasty shock, which could be deadly to those with susceptible heart conditions. It's also essential to never expose a flash unit to moisture or liquids.

7.71 Don't try this at home. Really. This is the interior of a high-powered studio flash unit. The large black cylinders are huge capacitors, capable of storing lethal amounts of power.

7.22.4 Noise

Flash units always produce sound. Battery units usually emit a high-pitched whistle that increases in frequency as the unit is charged up, caused by an oscillator that converts DC to the high AC voltages needed to charge the capacitor. Some units, like the 540EZ/550EX, have multiplexers that make a noise when idling. More recent EX models, such as the 580EX II, have deliberately high-frequency charging circuits so they're inaudible to the human ear.

Zooming units make a rattling buzz when the flash tube moves inside the head. Finally, all flash units make a soft popping sound when fired.

The 600EX/600EX-RT are the first Speedlites to contain beepers, which can be very useful for wireless flash setups. They're annoying, but they provide instant feedback that a remote flash unit is charged and ready to fire. ☐ 7.72

7.72 Custom function 20 on the Speedlite 600EX/600EX-RT controls the beeper.

7.22.5 Counterfeits

This may sound like a surprising problem, but there have been fake Canon Speedlites hitting the market for a few years now. Externally, they closely resemble high-end Canon gear such as the 580EX II or 600EX-RT , and may even have the Canon logo printed on them. But they're actually inferior copies, missing many key features such as high-speed sync and radio wireless. They may also lack proper safety functions. Another trick used to catch the unwary is to sell a bare-bones all-manual flash unit in a plastic casing that's an exact copy of a Canon Speedlite unit.

Be suspicious of too-good-to-be-true deals on online auction sites, as they may well be too good to be true! Buying from reputable dealers may cost a little more in the short term, but at least you know you've got somewhere to go back to if you do end up with an inferior product.

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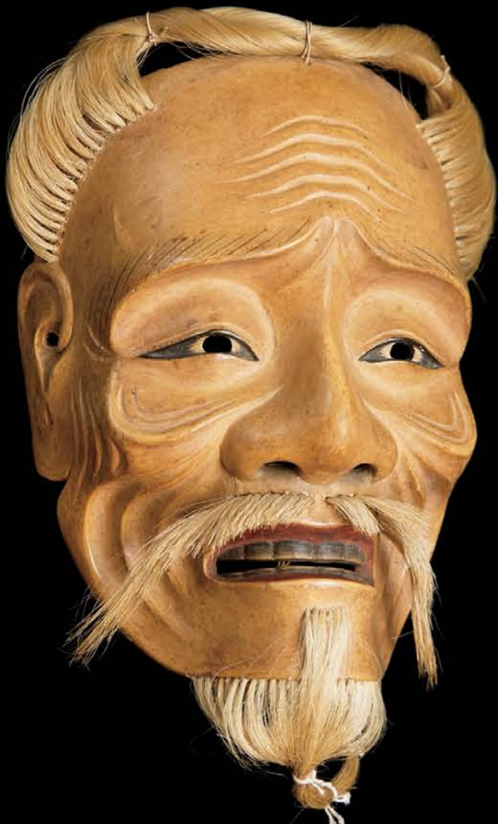
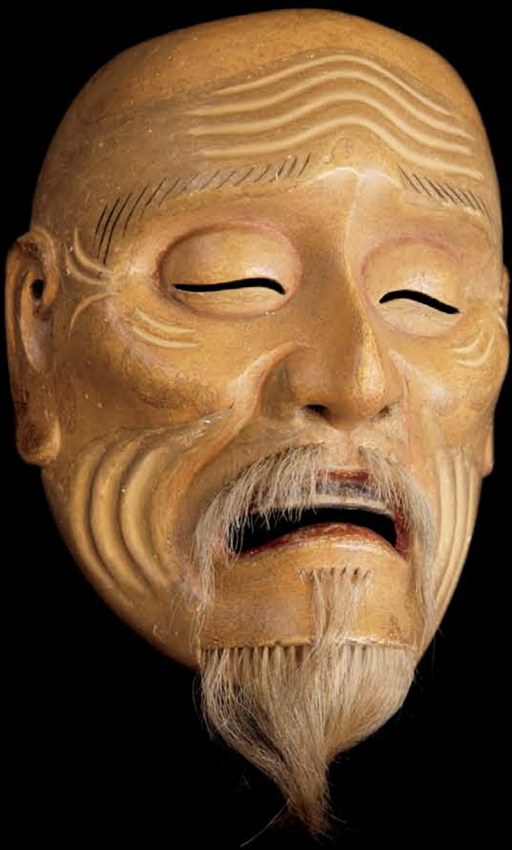
Part C: Equipment



8 Dedicated Flash Units

Six Masks. Historic Japanese Noh masks, courtesy Noh master Jiichi Asami of Shibuya, Tokyo, Japan. 580EX II flash unit on an off-camera shoe cord, shooting into a Westcott collapsible silver umbrella. Each mask was shot individually, then combined to form a single picture. EOS 5D, 1/60 sec at *f*/4, ISO 100, 70 mm.

This is an example of portable automatic E-TTL flash, using an off-camera flash unit with shoe cord.

KEY POINT
A *dedicated* flash unit is one that contains computerized electronics and that is designed uniquely for one particular camera maker's products.

In the early years of electronic flash photography, synchronization with the shutter was the only control the camera had over the flash unit. The output level and shutoff time were both determined by the flash unit itself, since two-way communications between camera and flash unit weren't possible.

In the 1960s and '70s, companies such as Honeywell, Braun, and Vivitar had thriving sales of autoflash units that worked with any SLR. Such generic products had simple electrical contacts to receive the camera's flash sync signal.

However, in the 1980s camera makers started building "dedicated" flash systems that would enable advanced features such as flash metering—but only with their own products. No universal standards were ever developed for camera-to-flash communications. In terms of automated features, a Nikon camera can't use a Canon flash unit, a Pentax flash unit can't be used with a Sony camera, and so on.

8.1 Built-in (popup) flash

The most dedicated flash units are those built right into the camera body. Nearly all consumer-level Canon EOS cameras have integral flash units in the angular prism or mirror housing. These internal units are handy for quick snapshots, since they're available at a moment's notice. They can't be misplaced or forgotten, can apply a little fill flash when outdoors, and recharge rapidly off the camera's own battery.

Built-in flash units are mounted on a hinged assembly and are normally retracted. Some are motorized and pop up immediately in most icon modes if the camera thinks flash is needed, or at the touch of a button when in a "creative zone" (letter) mode. A few have no motors and require the user to lift up the head manually.

8.1 Older EOS film cameras, such as the EOS 5/A2 (left), often had large flash housings containing motorized zoom mechanisms (section 9.5) and redeye lamps (section 9.8). Early digital EOS models such as the EOS 10D (center) eliminated the zoom motors and lamps, resulting in lower profile flash housings. Later EOS digitals such as the 50D (right) feature longer flash arms, allowing the flash head to be raised higher from the camera body.

8.2 The tiny EOS M3 mirrorless camera has this incredibly complex and delicate popup arm. Personally, I think a telescoping tube like a radio antenna would have been a sturdier mechanism for extending the flash head up, but then I'm not a camera designer.

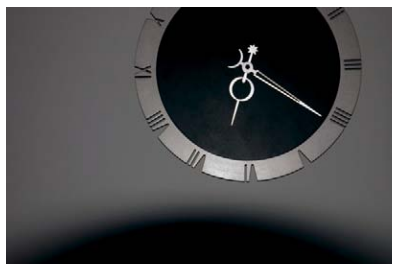
Most EOS film cameras use TTL metering for popup flash, whereas digital cameras use E-TTL. Some post-2007 cameras also support manual metering with popup flash. Canon sometimes calls built-in flash "serial controlled," meaning computer-controllable.

8.1.1 Popup flash limitations

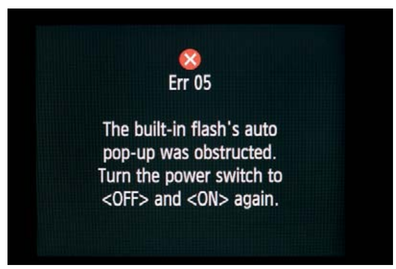
Unfortunately, built-in flash units have many drawbacks.

- They have very limited power output and range: typical guide numbers are around 11 to 13. This is fine for snapshots of friends in restaurants, but not much more than that.
- They're located fairly close to the lens, and so likely to cause the redeye effect.
- They don't extend very far above the camera body, so the light can be partially blocked by large lenses or large lens hoods. ☐ 8.3
- They don't tilt or swivel and generally have coverage areas of only 28mm or 35mm (18mm to 22mm on crop sensor cameras).
- They run down the camera's battery more rapidly.
- Only post-2007 cameras can use built-in flash as optical wireless E-TTL masters.
- Finally, and most importantly, they don't offer particularly nice lighting quality, since lighting rarely looks good originating from tiny on-camera sources.

You can't use internal flash and a shoe-mounted flash unit at the same time, as they'd physical collide. An EOS camera with a motorized internal flash unit has small electrical switches built into the hotshoe that detect the presence of a device and disallow internal flash popup, issuing errors BC, 05, or 83 depending on the model (figure 8.4). The internal flash won't rise automatically even if a bubble level or something else non-electrical is mounted on the hotshoe. The switches can also occasionally stick, rendering the internal flash inoperable.



8.3 The classic crescent shadow shown above is a hallmark of popup flash that has been blocked by a lens hood.



8.4 Error message 05, resulting when an external flash unit is mounted on the hotshoe.

None of the professional EOS cameras (1, 3, 5D, 6D series) have built-in flash units for the reasons listed above and because of the difficulty of weatherproofing a popup flash mechanism.

8.1.2 Improving built-in flash

It's pretty well guaranteed that if the popup flash is turned on and ambient light levels are low, you're going to end up with lousy photos. Or, to be more fair, harshly lit photos. This may be the whole point, and plenty of edgy fashion shots are taken this way deliberately, but generally speaking, built-in flash is a bad choice for aesthetics.

There are three ways around this. The first is to avoid flash altogether and rely on ambient light. The second is to use an external flash unit or units, particularly positioned off-camera. The third is to install a flash accessory over the built-in flash. These come in two forms: diffusers and reflectors.

Gary Fong Puffer

The Puffer is a small plastic diffuser that fits on a frame and slides into the camera's hotshoe. The frames avoid the shoe's sensors, which normally would disable the popup flash's electronics.

It's meant to enlarge the light-emitting surface area slightly and reduce its specular nature. It also spreads light around, which can be handy if there are nearby walls or ceilings for the light to bounce off. On the whole, it cuts the harshness a bit but doesn't reduce directionality, it's easily broken, and is an extra thing to carry. □ 8.5

8.5

Professor Kobré's Lightscoop

The Lightscoop takes a different approach. It's a mirror inside a plastic frame, which fits inside the camera's hotshoe. It reflects the light from a popup flash straight up to the ceiling, so it's completely useless if there's no ceiling. The device is meant for use indoors with light-colored low ceilings, or if you turn the camera to portrait orientation, the light can be direct toward a wall. □ 8.6

8.6

However, built-in flash units are pretty weak, and a lot of light is lost when it's bounced. For this reason, the manual tells you to set the camera to ISO 800, flash exposure compensation to +2, and the aperture to the widest setting possible.

If you're okay with shooting at ISO 800, then the device works well enough, but that's a significant drawback right there. It's also as big as a flash unit to carry around and, since it deflects most light upwards, it provides little frontal fill; you run the traditional risk of "raccoon eye" shadow.

8.2 Canon Speedlites

Canon has made many add-on flash units for its cameras over the years. All are marketed under the "Speedlite" name, and all are lightweight, battery-operated devices that plug into or fasten onto the hotshoe attachment of every EOS camera. All Speedlites since 1987 have been fully integrated with the Canon EOS system, offering automatic flash metering and other features.

8.7 The basic Speedlite lineup back in 2009: 270EX, 430EX II, and 580EX II.

They come in five basic physical configurations: small hotshoe flash units, standard and pro tilt-head hotshoe flash units, handle flash units, and macro flash units.

8.2.1 Small hotshoe flash units

These tiny pocket-sized boxes are the most basic models. Most have fixed flash heads that can't be tilted or rotated. They produce a bit more light than a popup flash unit, but their limited output restricts them to casual indoor photography, nothing more. They include Speedlites 160E, 200E, 300EZ, 90EX, 200EX, 270EX, and 270EX II. □ 8.8

8.8

8.9

8.2.2 Consumer-level tilt-head hotshoe flash units

This is what most people think of when they think of an external flash unit for a camera. Occasionally known as a “cobra” design because of its form, the L-shaped hotshoe flash with an independently tiltable head is ubiquitous; most camera makers produce similar products. The consumer-level units offer reasonable power output but most lack advanced features such as the ability to control other flash units wirelessly. They include Speedlites 320EX, 380EX, 420EX, 430EX, 430EX II, and 430EX III/430EX III-RT. ☐ 8.9

8.10

8.2.3 Pro-level tilt-head hotshoe flash units

The most full-featured flash units in the Canon lineup are the pro models, which are larger and more powerful than their consumer counterparts. They often support features such as wireless master control, rapid recharging, stroboscopic output, and weatherproofing. They include Speedlites 420EZ, 430EZ, 540EZ, 550EX, 580EX, 580EX II, and 600EX/600EX-RT. ☐ 8.10

8.2.4 Handle flash units

Canon only made only one model of this design for EOS cameras, but some other makers, such as Metz, continue to produce them. They’re large, high-output devices made in the shape of a big handle or grip with an integral flash bracket. They are often used by news photographers and the like. This is the film-only Speedlite 480EG. ☐ 8.11

8.11

8.2.5 Macro flash units

These are specialized flash units with small flash tubes that fasten to the end of a macro lens. They may have a ring shape or independently movable heads. Because they’re intended for close-up photography, they don’t have particularly high light output, making them unsuitable for general photographic use. They include the Macro lites ML-3, MR-14EX, MT-24EX, and MR-14EX II. ☐ 8.12

8.12

8.3 Speedlite naming scheme

The nomenclature of Speedlites is consistent and fairly logical. Here's what "Speedlite 580EX II," a typical example, means.

Speedlite	The product name for most Canon external flash units (versus "Speedlight" for Nikon)
580	The maximum guide number (an output rating of the flash in meters) multiplied by 10 to make it sound cooler
E	Works with EOS cameras
X	Supports E-TTL flash technology
II	This unit is the second model to have this particular configuration (most flash units lack a Roman numeral designation, since the I is implied).

All Speedlites shipping at time of writing are EX units, and most work with the majority of film and all digital EOS cameras. Units starting with "M," such as the MT-24EX, are macro flash units. Other ending codes include the following:

Letter code	Examples	Meaning
E	160E, 200E	EOS TTL for film cameras only
EZ	430EZ, 540EZ	EOS TTL and A-TTL for film cameras only; zooming flash heads
EG	480EG	Grip-shaped TTL-only unit
EX	220EX, 580EX	EOS E-TTL for film and digital cameras; current series
A	199A	For manual-focus A series cameras such as the A-1; not compatible with EOS
T	299T	For manual-focus T series cameras such as the T70; not compatible with EOS
TL	300TL	Designed for the T90; partially compatible with TTL film EOS cameras
M	200M	Autoflash only and no support for TTL
RT	600EX-RT	Support for radio technology for wireless control

Although this naming system is reasonably logical and consistent, it's easy to confuse different models that happen to have identical guide numbers. For example, the 430EZ and 430EX flash units are completely different products despite the single letter difference, as are the 420EZ and 420EX. It thus pays to be very careful when shopping for used flash products. EZ units, for example, are not compatible with digital EOS cameras.

8.4 Older Canon Speedlites

Older Canon Speedlites lack the letter E in their names and predate EOS cameras. They are not useful with modern cameras.

Such units will physically fit an EOS camera's hotshoe and may trigger at full power when a photo is taken, but they can't use modern automated flash metering. They have to be used in autoflash mode if they have such a setting (set the camera to a shutter speed up to the camera's X-sync) or in manual mode if they have manual controls (most don't), or else the units

8.13 Canon Speedlite 300TL

8.14 Sigma EF-530 DG Super Flash unit

will fire at full power. Many should have a safe triggering voltage, but always check before attaching one of these vintage units to a camera.

The one exception is the 300TL. It was designed for the Canon T90 but can be used with EOS film cameras in basic TTL mode. ☐ 8.13

8.5 Third-party flash units

A number of companies ("third parties" such as Metz and Sigma) sell flash units for the EOS system. However, Canon has never published or licensed the data protocols—the digital language—used by its cameras. So, any flash product billed by a third party as being Canon compatible has been made through a process known as reverse engineering. The third parties have examined the behavior of existing Canon products, deciphered the command language used to control them, and made their own compatible products.

While reverse engineering is effective when done diligently, there is one significant risk. Canon can alter the design of its products at any time. When this occurs, there is the possibility that older third-party units will not be able to communicate with newly released products.

Occasionally Canon will introduce a new line of products that breaks compatibility with previous products. For example, the switch from film to digital meant that newer digital cameras could not use older TTL flash units. Generally speaking, however, Canon ensures that new products can operate well with its older lineup. A brand new Speedlite 600EX-RT, for example, will work just fine on an EOS 650 camera from 1987, though of course the camera won't be able to use of all the Speedlite's new features. Be cautioned that Canon does not test third-party products for compatibility issues during development; Canon just tests its own.

8.15 Mecablitz 15 MS-1 ring flash

Some third-party products are upgradable to avoid this risk. For example, more recent Metz and Yongnuo flash units have USB connectors so the latest firmware (internal computer software) can be downloaded from the Internet to the flash unit if the manufacturer releases an update to improve compatibility or to fix bugs. Most third-party units do not have this level of “future-proofing” built in, though it’s sometimes possible to send a unit to the manufacturer for firmware upgrades.

Another common problem involves AF assist lights. Almost all third-party flash units cannot illuminate the AF assist light when a focus point other than the center point is selected on a multiple focus point camera.

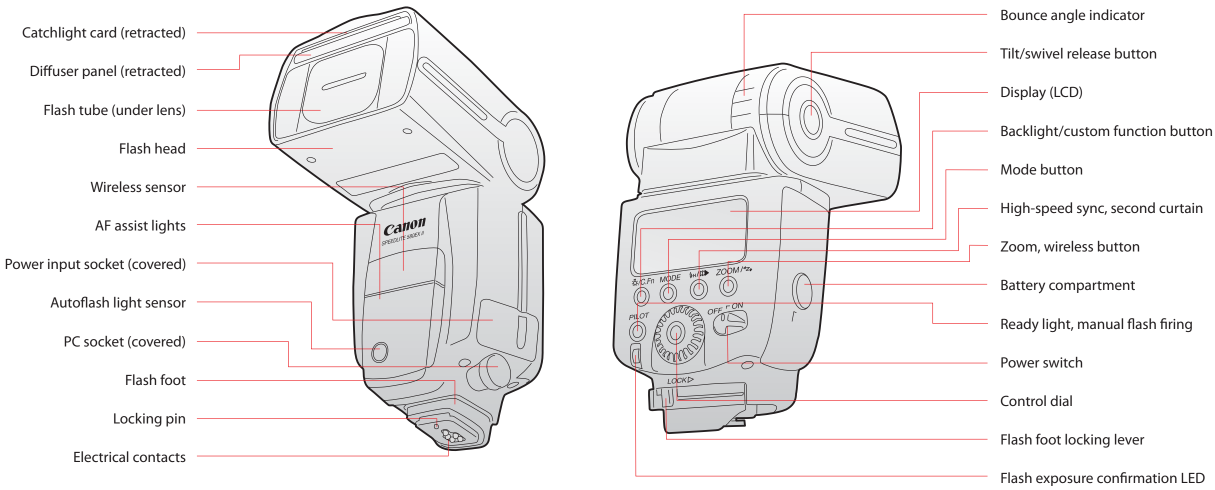
8.16 This small USB mini B socket is used for upgrading the firmware on a Yongnuo flash unit.


MACRO TWIN LITE MT-24EX
Canon
Canon
Canon
Canon
Canon
Canon

9 Canon Speedlites

The Whole Family. A representative of every E-series Canon Speedlite produced between 1986 and 2009.

Canon Speedlites are compact, battery-powered, automatic flash units sold by Canon since the 1970s. And this is a comprehensive and exhaustive (if not exhausting) list of the features offered by post-1987 Speedlites that are compatible with EOS cameras. Not every model has every function, of course. Check the table in appendix C for details.



9.1 Key parts of a Speedlite 580EX II flash unit

9.1 Hotshoes

9.2 Black painted metal hotshoe

9.3 Unpainted metal hotshoe

Hotshoes are the traditional, square shaped slide-in sockets on the top of all EOS cameras, and indeed most SLRs sold today. Despite the dramatic name, hotshoes carry no risk of electrocution and don't get warm. "Hot" is just slang for their electrical connectors, though non-electrical accessories such as bubble levels and flash diffusers can also be mounted on them.

The earliest hotshoes from the 1940s had a single electrical contact in the middle that carried the synchronization signal. The metal frame served as an electrical ground; a design still used today. EOS cameras have four additional small contacts arranged behind the main stud. These carry computer instructions, supporting advanced features such as flash metering and flash head zooming. The signals sent by these four contacts are unique to Canon—each modern camera manufacturer uses its own pin arrangement and camera/flash communications system.

For a while, Canon painted hotshoe frames black, which looks great out of the box. However, the paint tended to scratch and flake off, sometimes insulating the connectors, so EOS bodies now have unpainted metal shoes.

Hotshoes are something of a weak link in the chain of any flash system. They were initially designed over half a century ago for small devices ("cold" accessory shoes were simply brackets with no electrical connectors) and have been modified over the years by different manufacturers to accept increasingly large flash units. Nearly all makers, with the exception of Sony/

Minolta, use the same basic hotshoe design, though with different contact configurations.

9.4 Flash foot with collar and pin

9.1.1 Flash feet

The base of a flash unit that fastens to a hotshoe is known, logically enough, as its foot. Over the years Canon has used five basic types.

The oldest models are plastic, with rotating pressure rings to clamp the flash down. The tightening direction is usually marked with an arrow, and sometimes with “L” for lock. The main drawback of these feet is that the rings can occasionally bind, making it difficult to remove the flash unit. In such cases, try tightening slightly, then firmly untightening the ring.

Later feet have pressure rings with a small retractable pin at the front. This pin lowers into a matching hole in the shoe, helping it lock in place. The pin is spring-loaded, so the flash will still fit in hotshoes that lack the locking pin hole.

Larger and more recent Speedlites have a metal latching foot. Billed as sturdier than the plastic design, there may also be a rubber shroud which matches the gasket on weatherproofed cameras, minimizing water and dust penetration. (See section 9.34 on weatherproofing.) Instead of a ring, there’s a quick-release latch. Turn the latch one way to lock it; press the release button and turn it the other way to unlock it. ☐ 9.5

9.5 Flash foot with collar and pin

These newer latches are easy to operate, but they don’t always tighten as firmly as the pressure ring design, especially if the camera is held sideways in portrait configuration. If this occurs, inconsistent contact with the connectors may result. A flash unit might, for example, suddenly switch from E-TTL mode to TTL if it loses communication with the camera. On a digital body, this can mean the flash unit fires at full power or not at all. ☐ 9.6

9.6 Flash foot with quick release

In 2012, Canon introduced a variation on this design for its high-end flash units: a mechanism slides the electrical pins first one way and then the other as the tightening lever is moved. This is marketed as a “self-cleaning” mechanism, since the motion hopefully will dislodge debris. ☐ 9.7

9.7 Self-cleaning foot mechanism.

Finally, tiny inexpensive flash units have simple sliding latches. ☐ 9.8

9.8 Foot with latch

If a flash fails to fire reliably, the first things to check are the flash foot and camera hotshoe. The contacts may require gentle cleaning, or the screws holding in the shoe might need tightening. Never use anything more

than a soft cloth to clean the contacts, though a drop of deoxidizing contact cleaner can help. Pencil erasers and emery cloths are abrasive and will permanently damage the contacts over time.

Note that it's a bad idea to lift a joined camera and flash unit by the flash unit, as this puts a lot of strain on the foot and shoe. Pick up the camera body to reduce the risk of damage!

9.2 Flash heads

In keeping with the body metaphor, the part of the flash unit with the light-producing flash tube is called its head. The tube is mounted inside a small reflector and covered with a protective plastic lens. The lens is molded in a Fresnel-type pattern to concentrate the light output. There's sometimes a slightly yellowish tint to the plastic to help make the flash-produced light slightly less blue. ☐ 9.9

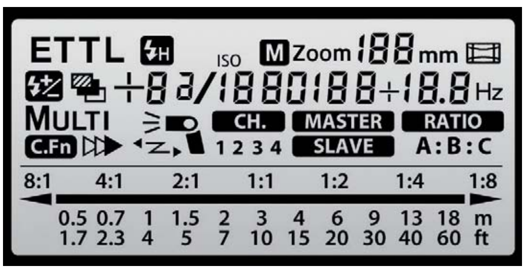
9.9

9.3 LCDs

Higher-end Speedlite flash units, including all the 500–600 series models and most of the 400 series models, are equipped with liquid crystal display (LCD) panels. Until the introduction of dot matrix displays in 2012, each LCD had a specific set of symbols and numbers etched into it. LCDs have optional backlights for low-light operation, and are illuminated for a few seconds at the touch of a button.

This is all the information that can be displayed on the LCD of a 580EX II unit, though of course it never actually looks like this at any one time. Panels of this type have specific areas used for the display of certain symbols or numbers. They're sharp and crisp, but completely inflexible—they can only display the symbols etched into them. ☐ 9.10

9.10



9.3.1 Dot-matrix LCDs

In 2012 Canon introduced three high-end units, the 600EX, 600EX-RT, and ST-E3-RT, which feature black and white dot-matrix displays. These were followed by the Macro Ring Light MR-14EX II and Speedlite 430EX III/430EX III-RT.

The panels on these units are the largest ever seen on a Speedlite, and of course they can display any graphic, icon, or text like any computer screen. Unfortunately, the display dot density is fairly low-rez at 172 × 104 pixels, so some symbols are a bit chunky, and reversed text is a little hard to read compared to the old-style LCDs. It would be nice if they had full-color displays like mobile phones, though black-and-white displays do have a better battery life. ☐ 9.11

9.11

The 600EX, 600EX-RT, ST-R3-RT, and MR-14EX II units also have a group of four function buttons immediately below the display. These buttons aren't physically labeled and can change function based on the label that appears above them, making the new interface very flexible. These Speedlites therefore have contextual menu-based systems. The 430EX III/430EX III-RT units have an on-screen menu that is mostly navigated by the control wheel. ☐ 9.12

9.12

The new displays also mean that previously inscrutable numbered custom functions are displayed visually on the screen. No longer do you have to photocopy your flash unit's user manual so you can look up what custom function number corresponds with what actual feature!

The LCD and the buttons are also backlit, and can be manually set to green or orange. The non-macro units can also automatically change color depending on whether they're operating in master/non-wireless or wireless slave mode (very useful for getting remote flash set up at a quick glance), and can also light up red if they overheat.

9.4 Swivel and tilt for bounce flash

9.13

Most Speedlites, with the exception of small pocket units, have flash heads that can be tilted and swiveled to point independently of the body. This lets you bounce light off large surfaces such as walls or ceilings. It also means the flash head can point one way while the front of the unit's body, where the optical wireless sensor is located, can face back towards the camera. Tilting on non-macro units is usually adjustable from 0° (straight forward) to 90° (vertically upwards), with 500–600 series units allowing a 7° downwards tilt for slightly improved close-up photography. □ 9.13

Swiveling usually goes from 0° to 180° left, which is facing backwards. Right swivel is either 0° to 90° or 180°, depending on the model. There are click stops at various detent positions, and most units have spring-loaded tilt latches. Recent models conveniently use a single pushbutton latch to unlock both tilt and swivel. Some units with LCDs show a small icon indicating whether the head is tilted or not. □ 9.14

9.14

The ability of some Speedlites to know whether the flash head is in bounce mode is used by some cameras. When ISO is set to AUTO, some EOS bodies after the Rebel T1i/500D and 7D will increase the ISO if a flash unit in bounce mode is detected, compensating for the reduction in range.
Low-end flash units lack tilt and swivel heads, but by simply attaching the flash unit to an Off-Camera Shoe Cord (section 11.5.1) you can point the flash in any direction you want. However, cheaper flash units are also low-power models, so this technique isn't always useful.

9.15 While tilt and swivel are normally used for bounce flash, they have other creative uses as well. In this shot, the on-camera 580EX II was deliberately angled upwards to illuminate the model while keeping the lower half of the freight elevator dark and mysterious.

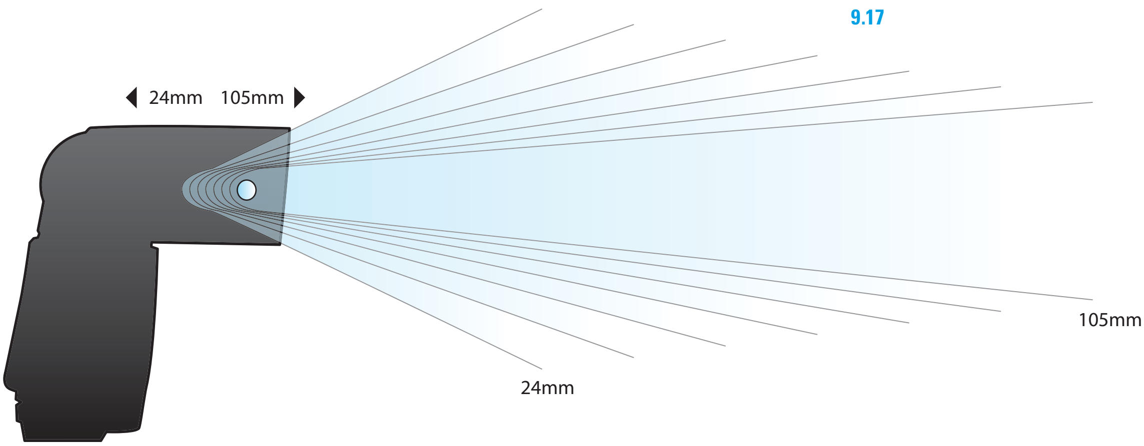
9.5 Zooming flash heads

The area of a scene illuminated by a flash unit needs to match, or slightly exceed, the field of view of the lens in use. If you've got a wide-angle lens, but your flash unit doesn't cover the full area, your photos will have a darkened periphery. ☐ 9.16

9.16

The converse can also occur. A flash unit that covers a wide area will waste a lot of light illuminating areas of a scene that aren't captured by a longer lens. ☐ 9.17

9.17



To solve this problem many Speedlites have adjustable coverage areas, thanks to small motors that move the flash tube. The closer the tube is to the clear plastic Fresnel lens at the front, the wider the coverage angle, and vice versa. This is a "zooming" flash head.

9.18 The guts of a 580EX's flash head, showing the stationary white plastic reflector on which the flash tube assembly slides. The flash tube, mounted inside a silver frame, is surprisingly small. Note that you should never open up a flash unit like this, as dangerously high voltages remain inside the device even when the power is switched off. There's a serious shock hazard if the wrong part is touched!

Most units cover the range of 24–80mm or 24–105mm lenses, though the 600EX/600EX-RT goes to 200mm. The motors have several detented steps matching popular prime lens focal lengths, such as 24–28–35–50–70–80–105mm. Continuous zooming to arbitrary focal lengths is not supported.

A flash unit's upper zoom limit doesn't mean it's incompatible with longer lenses: it just means that it can't concentrate its light for more efficient coverage of a narrower area. The reverse is not true at the wider end. For example, a flash unit with 24mm coverage at the wide end will cause a vignetting effect (darkening of corners or edges) when used with a 17mm lens.

Generally speaking, only mid- to high-end flash units can zoom, as the heads have to be larger and longer to accommodate the mechanism. It's also important to remember that a flash unit's advertised maximum power output might actually be partly related to its longest zoom setting and not to the actual maximum light output of its flash tube.

9.5.1 Automatic zooming

Speedlites with motorized heads can adjust zoom settings automatically to match the lens. Canon EF and EF-S lenses—and fully compatible third-party lenses—contain computer chips that send the current focal length to any EOS camera. Likewise, EOS bodies can communicate with compatible flash units that are either on the camera's hotshoe or connected using a fully compatible cable. (Cables that carry sync signals only, such as PC cables, will not transmit automatic zoom position commands.)

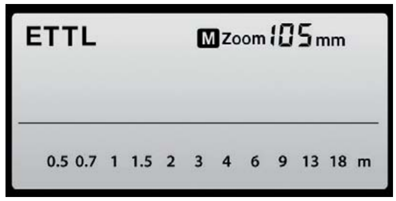
When the shutter release of a connected compatible camera is pressed halfway, motorized Speedlites use the nearest zoom setting that's equal to, or less than, the focal length of the lens. They automatically change motor positions with a little whirring buzz if the zoom position is changed within six seconds of the shutter button being half-pressed, or if the button is continuously held down in the halfway position.

This automatic zooming occurs whenever the flash head is pointing directly ahead. Speedlites typically default to a 50mm zoom setting when their flash heads are in bounce mode (i.e., tilted or rotated). If a non-EF lens is attached (an old fully manual lens attached to the camera using a lens adapter ring, for example), or if an EF lens isn't fully locked onto the camera, then the camera has no way of knowing what the focal length is. It will then typically default to a 35 or 50mm zoom setting.

Wireless-capable units with zooming heads (section 11.8) automatically zoom to 24mm when in wireless slave mode.

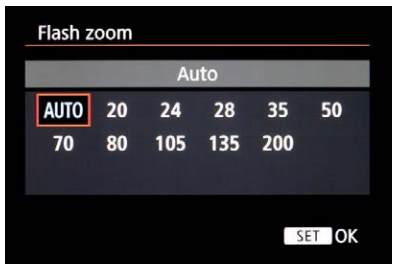
9.5.2 Manual zooming

Most motorized flash units can override automatic zoom. This is typically done by pressing the button marked ZOOM. On the 600EX/600EX-RT, press function button 1 (Zm/C.Fn). On the 430EX III/430EX III-RT press the center ZOOM button then rotate the dial. On flash units with combined zoom/wireless buttons, use the control dial or +/– buttons to adjust the setting. On other flash units, press the ZOOM button repeatedly to cycle through the settings.



9.19

The focal length setting will go around, step by step, in a loop as it's adjusted, accompanied by the buzz of the flash head motor. The letter M will appear next to the zoom setting if set manually. Some units also display A ZOOM if the unit is in automatic zoom mode. If the zoom setting displays – –, it means the flash head is tilted or swiveled in auto mode. (Zoom position can still be manually overridden.) If the lowest zoom setting possible blinks continuously on the LCD, then the current focal length of the lens is shorter than the flash unit's widest coverage.



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Cameras with menu control over compatible Speedlites can also adjust zoom settings via a menu option.

Some inexpensive models such as the 270EX and 320EX lack motors altogether. Their zoom heads must be slid back and forth by hand.

9.21

9.5.3 Creative zooming

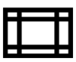
While adjustable flash coverage is intended to increase light efficiency when using longer lenses, it's also a useful creative tool. A flash head can be deliberately zoomed out to a longer focal length to concentrate the light. This lets the flash unit work like a sort of soft-edged spotlight, sending pools of light to specific areas. In a sense, the flash unit behaves a bit like it would if a snoot or other light-restricting device were installed. Adjusting zoom coverage is also useful for ensuring that a flash unit's light fills an umbrella or reflector.

Consequently, zooming heads with manual control are a particularly useful feature for a flash unit that's used off-camera. Each slave unit can have its coverage angle set independently.

9.22 This performance photograph was lit primarily by available lighting—a pair of stage spotlights. But for added drama, a Speedlite 580EX was positioned behind the performers on a Manfrotto nano stand. The head was zoomed out to 105mm in order to create a narrow beam, providing a backlit spot effect.

9.5.4 Zoom compensation

Camera bodies with image areas smaller than 35mm film (APS film cameras and most EOS digital cameras) don't require as much area illumination as 35mm / full frame digital cameras because of the cropped frames. So a flash unit designed for a 35mm camera is, in effect, wasting light when taking a photo using a cropped sensor camera, since areas outside the edges of the picture will be illuminated unnecessarily. This ends up costing flash range and wasting batteries.



Most EOS digital cameras and Speedlite flash units can compensate for small sensors automatically. When a compatible camera / flash unit combination is used, a small nested rectangle icon will appear in the flash unit's LCD, showing that the flash unit knows to adjust for the reduced size of the sensor. Such flash units actually have the ability to set the flash zoom to detented positions between the common points, but not in a user-adjustable fashion.

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9.5.5 Light distribution

The 430EX III, 430EX III-RT, 600EX, and 600EX-RT all have a feature called “light distribution” that subtly alters the zoom setting of the flash head. There are three modes: standard (default), guide number priority (the flash zooms in a bit for increased range at the cost of some darkening of the periphery), and even coverage (the flash zooms out a bit for more even illumination across the frame, though at the cost of range). ☐ 9.25

9.25

9.5.6 Zooming camera flash

Two EOS film cameras, the Elan/100 and the A2/5, had three-position zoom motors built into their popup flash units. This was a short-lived experiment: the expense and bulk of the mechanism outweighed the benefit of slightly higher guide numbers.

9.26

9.6 Flash head diffuser panels

The 500/600-series and some 400-series Speedlites contain pull-out “wide” or “diffuser” panels. These translucent plastic panels slide out and flip down over the head to widen the coverage, though at the cost of limiting the range since the light is spread over a wider area. They typically cover 14mm, 17mm, or 18mm.

These panels help with wide-angle lenses, but only to a point. Fisheye lenses are a particular problem, since they have such wide coverage (nearly 180° diagonal for 15/16mm fisheyes, and nearly 180° vertical for 8mm fisheyes). Third-party diffusers (figure 12.2) that simulate a bare bulb are needed for fisheye coverage.

9.27

When a panel is extended, auto zoom is set to its widest position and the zoom motor is disabled. If the flash head is swiveled or tilted when the panel is extended, then the LCD will blink, or ! WP will appear. This is a warning that the wide panel is being combined with bounce mode, something Canon does not recommend.

The pull-out diffusers are delicate and must be treated carefully. If either the panels or their internal switches break, the flash unit will think the panel is permanently extended and zooming will be disabled. If this happens on a 540EZ, turn the unit to SE mode while keeping the MODE and ZOOM buttons pressed to re-enable the zoom motor. On later models, try to push the panel all the way back into the flash head.

These panels can also serve as weak reflective “bounce cards” if they are pulled up partway and left to extend vertically from the head. However, the panel is more vulnerable to breakage if used in this way.

The 200E, 200M, and 480EG units also have optional clip-on diffuser panels that increase or decrease the coverage area of the flash heads. ☐ 9.28

9.28

9.6.1 Catchlight panels

Some mid- to high-end Speedlites have small, thin, white plastic cards that reside alongside the diffuser panels inside the flash head. They’re much like fastening an index card to the top of the flash head with a rubber band, only they are more convenient and they can’t get lost. Normally they’re used with the flash head tilted so that the card points vertically up. This directs the majority of light upward, while the card reflects a small amount of light forward onto the subject.

The idea behind these cards is to create a tiny amount of fill light and, more importantly, to cause a small bright area (a “catchlight”) that can be reflected back from a person’s eyes when in bounce mode. ☐ 9.29

9.29 To use, pull out the diffuser and catchlight card together, then hold the card and push the diffuser back in.

9.7 Autofocus (AF) assist light

Point-and-shoot cameras from many years ago sometimes had “active” autofocus mechanisms that projected a beam of light or infrared. This energy would reflect back from a subject and be used to measure focus.

Modern cameras with “passive” autofocus mechanisms, including all EOS models, work on a different principle. They don’t normally send out any light themselves, but instead analyze the light reflecting back from a scene. This usually works quite well, but even good AF systems like the phase detection sensors used by EOS cameras are stymied by low light levels, especially when trying to focus on a featureless low-contrast surface such as a wall.

For this reason, most Speedlite flash units and some EOS cameras can optionally shine a little light in order to give autofocus a helping hand when light levels are low. These AF assist lights come in different forms. They may

9.30

be a relatively discreet patterned red light from a bright red LED, a dazzling white incandescent light, or a rapid-fire strobe of the main flash tube. ☐ 9.30

9.7.1 Red AF assist lights

Most better quality Speedlites have patterned red AF assist lights (sometimes called AF auxiliary lights in older Canon manuals) at the front. These lights use one, two, or three high-brightness LEDs to project red circles of light striped with dark lines. When ambient light levels are low, the LEDs can illuminate automatically, giving the camera's autofocus system something to focus on. The stripes form high-contrast edges, making it possible to focus on blank surfaces such as a white wall. ☐ 9.31

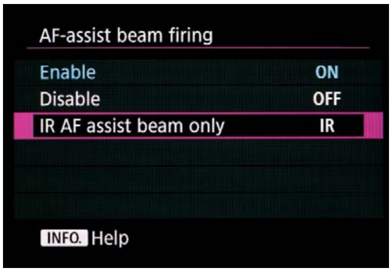
9.31 The red AF assist lights project red striped patterns.

While AF assist is great in low-light conditions, it does slow autofocus down. This is because the light needs to fire at least a couple times—once to give the AF system a target to focus on, and a second time to confirm that focus was attained. The process is repeated if AF still fails, which is particularly likely if the subject moves between AF assist firings.

The maximum range of the AF assist light varies from unit to unit, but is typically around 5–10 meters/15–30 feet from flash unit to subject. The range is usually lower for autofocus points away from the very center.

The red AF assist lights can blink if a Speedlite is in wireless slave mode, as a reminder that it's charged up and waiting to be triggered remotely. The lights also help line up the slave units to their targets. The 600EX/600EX-RT can disable this feature, but the only way to disable it on other flash units is to apply some black tape.

AF assist illuminates only if the camera is in one-shot drive mode, and will not work in AI Servo or in any icon AE mode that employs AI Servo, such as Sports mode. This is because the camera is constantly focusing and



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9.33

refocusing in AI Servo mode as it tracks subject motion. AF assist also shuts off in Live View mode.

The red light is sometimes incorrectly called “infrared,” even by Canon, but it’s quite visible to the human eye. It’s also easily seen by other cameras, which can be a problem during weddings and other events recorded on video. ☐ 9.32

9.7.2 Red AF assist and multiple focus point minutiae

If the camera body has multiple focusing points and the Speedlite’s AF assist light doesn’t light up in low light, it’s probably because the AF light on the flash unit can’t cover the currently selected (i.e., non-center) focusing point. Many flash units have AF assist lights, which can only illuminate the central point. Switch to the central focusing point, and the Speedlite’s AF assist light should start working. Additionally, there are focal length limitations. Most Speedlites cannot provide AF assistance if a lens wider than 28mm is in use and a focus point other than the central point is selected.

As for the coverage of these AF lights and multiple focus points, it depends on when the flash unit was introduced and its position in the marketing lineup. For example, the 430EZ flash was introduced at a time when all Canon cameras had only one focusing point, and so its AF assist light cannot cover the non-central focusing points of multiple-point cameras. By contrast the 420EX covers all seven points used by later cameras, and the 430EX and 430EX II cover nine points. The 500 EX series units can cover all 45 points of the area focusing system used by most 1 series cameras, and the 600EX/600EX-RT can cover all 61 points used by the EOS-1D X and 5D mark III.

Coverage depends in part on the number of LEDs the unit has. Many Speedlites have a single red AF assist LED, but some have two (e.g., the 430EX) and some have three (e.g., the 580EX). Which LEDs activate in multi-LED units depends on which focus point or points are selected. Some LEDs project horizontal lines and others vertical.

Some flash units cover all nine AF points if the focus point is selected manually, but fail to illuminate the upper or lower points if they are selected manually because of firmware limitations. The majority of third-party flash units can only cover the central point if they have AF assist lights.

Finally, a few early film bodies such as the EOS 10/10s only fire their body-integral lights and can’t use the Speedlite’s AF assist.

9.7.3 Flash brackets and alignment

Red AF assist lights are carefully aligned so that they correctly illuminate the area covered by the lens. However, if the flash is moved off camera with an off-camera shoe cord or flash bracket, the AF lights may go out of alignment. AF lights can also be blocked by add-on accessories, such as some softboxes and ring light attachments.

9.7.4 White light macro AF assist

Canon macro flash units have small incandescent bulbs or white LEDs for modeling and focusing rather than red AF assist LEDs. Conveniently, the Macro Ring Lite MR-14EX II and Macro Twin Lite MT-24EX can be configured so that double-tapping the shutter release halfway turns these lamps on. The ML-3 and MR-14EX require a press of the controller-mounted “lamp” buttons to enable the lamps.

The earliest EOS digital bodies, the D30 (not the 30D) and the D60, have bright white lights for limited autofocus assist. The Speedlite 320EX also has a white LED, which can be used as an AF assist light or as a small light for video recording.

9.34 Macro Ring Lite MR-14EX II

9.35 Speedlite 320EX

9.7.5 Flash tube pulsing for AF assist

Some film-based EOS cameras have an AF assist light built in, but few digital bodies do. As a substitute, some EOS bodies with popup flash units can fire a bright staccato burst of light to help low-light autofocus. This is cost-effective since no additional LEDs are required, and it always covers all focus points on the camera. Unfortunately, it’s also very distracting and irritating, and it does not help the camera focus on featureless surfaces such as white walls since no striped pattern is projected. Fortunately, most cameras with this annoying feature can disable it, though at the cost of low-light focusing.

Some cheaper Speedlites such as the 90EX, 270EX, and 270EX II lack a separate AF assist light and use the flash tube this way. However, this functionality only works with digital EOS bodies with external Speedlite control menus. Or, if you really want the feature, first enable it on a newer camera, and then move the flash unit to the older model. 9.36

9.36 Speedlite 270EX

9.7.6 Disabling AF assist; disabling main flash

Advanced Speedlite models and many cameras have the ability to shut off the AF assist light if it's obtrusive. All Speedlites with custom functions have one for disabling AF assist, as do many cameras. If both the camera and flash unit have an AF assist custom function, it appears that setting either to "Disable" will shut off the feature. Some cameras can also enable the AF light on an external flash unit while disabling the internal AF assist. Most later digital EOS bodies can control a Speedlite's custom functions from the External Speedlite control (ESC) menu.

9.37

Some camera/flash unit combinations can let an external AF assist light illuminate while preventing the flash tube from firing, which is a useful solution for improving low-light autofocus performance. This is usually done through a custom function or menu item. To do this on a camera with ESC compatibility, for example, go to Flash Control and select Flash firing. Set it to Disable. Be sure that the flash unit is set to emit the AF assist. □ 9.37

Some cameras from the EOS 7D onward are capable of distinguishing Speedlites that have true AF assist lights (incorrectly described in camera menus as "IR AF assist beam only"—they are red but not IR—from units that pulse the main tube. Such cameras can be set to allow true AF beams to fire while disabling the annoying main tube pulse.

9.7.7 AF assist with the Speedlite Transmitter ST-E2

The Speedlite Transmitter ST-E2 is a small master device that uses optical wireless E-TTL to command slave flash units, but which can't produce any visible white light itself. However, it does have autofocus assist LEDs. If your camera has poor low-light autofocus, you may find the ST-E2 useful, since it's small and runs for ages on a disposable lithium battery (though when it's on, the minimum shutter speed in P mode drops to 1/60 sec). Unfortunately, the Speedlite Transmitter ST-E3-RT for radio lacks AF assist LEDs. □ 9.38

9.38

9.8 Redeye and greeneye

Redeye, the bane of point-and-shoot snapshots, occurs when light hits the fine red mesh of blood vessels lining the retina of the eye and is reflected back to the camera. Glowing red eyes, like a cheesy special effect from a low-budget movie about demonic possession, are the result.

9.39

While common in photographs, redeye is rarely seen by the naked eye for three reasons. First, the light source has to be much brighter than the ambient lighting. Second, the subject's pupils must be quite dilated (open) for the reflected red light to be noticeable. And third, and most important, the light source has to be as close as possible to the viewing axis (i.e., to the eye of the viewer).

Unfortunately, these three conditions are met handily when doing flash photography in dim lighting. Flash involves a tremendous burst of light. Since ordinary consumer flash units are attached to the camera or built into the camera body, they're often located very close to the lens. Tiny point-and-shoots are particularly vulnerable to the problem, partly because they tend to be used in low-light situations like restaurants and living rooms, and partly because their built-in flash units are located very close to the lens.

Flash photography of cats and dogs can involve a related problem called greeneye. Cats and dogs have a reflective membrane in their eyes called the *tapetum lucidum,* which helps their night vision. The tapetum reflects light very efficiently and tends to color it green, yellow, or blue. The membrane also causes the eyes of animals by the side of the road at night to be visible as brilliant points of light. Humans lack this layer, so we don't have tapetal reflections. ☐ 9.40

9.40 The eerieness of greeneye in a cat.

9.8.1 Redeye reduction

Redeye can be colored over with a black pen on the final prints or painted over using image-editing software, but these are obviously crude solutions. The best ways to get rid of redeye are either to avoid flash altogether or to move the flash unit as far away as possible from the lens (while still illuminating the scene effectively, of course!).

9.41 A Canon G9 point-and-shoot, a 50D with popup flash, a 50D with shoemount Speedlite 430EX, and a 50D with a 430EX on a Custom Brackets CB Junior bracket. Note the relative distances between the center of the lenses and the center of the flash units.

Good techniques for reducing redeye are to use off-camera flash, put the camera onto a flash bracket, or tilt the flash head so that light bounces off the ceiling or the wall. Unfortunately, none of these techniques are possible with a camera's unaided built-in flash unit.

One drawback to moving the flash unit, aside from the inconvenience, involves low-light photography. When light levels are low, the pupil of the eye dilates to let in more light, just like a lens diaphragm. If a flash photo is taken of a person, the irises don't have enough time to react to the burst of light, so the pupils remain dilated and huge.

9.42

Because redeye compensation techniques are inconvenient, camera makers have come up with another solution: shine a bright light into the eyes first, which makes the pupils contract and less likely to reflect red light. Some consumer-oriented cameras have redeye reduction lamps—bright white lights or short pulses of blinding light from the popup flash unit. Unfortunately, these lights usually have the effect of making people look dazed and stunned. Blank and glazed, or red and evil looking: with onboard flash photography, the choice is yours!

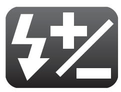
Redeye reduction is typically enabled by a menu item or pushbutton, and is indicated by a small eye icon (figure 9.42). Many cameras show a graphical countdown timer while the redeye reduction light is glowing. This is meant to guide the photographer as to how long their victims must stare into the light to let their pupils contract. ☐ 9.43

9.43

None of these tricks are particularly useful for photographing pets, whose eyes are like reflective road signs or safety tape on high-visibility vests. In these cases, off-camera or bounce flash is the way to go. The light is still reflected back to the source; it just happens to be in a different location than the camera lens.

9.9 Flash exposure compensation (FEC)

Flash exposure compensation is the ability to manually increase or decrease a flash unit's power over the automatically chosen output setting. How FEC is applied depends on the camera and body being used. Many EOS cameras can specify FEC by pressing a button marked with the FEC icon. This engages FEC mode, and rotating the camera's dial will adjust the flash output. ☐ 9.44



9.44

Usually the FEC button is tied with another function, such as metering mode or ISO. In such cases, and if the camera has two control dials, each dial controls a separate function.

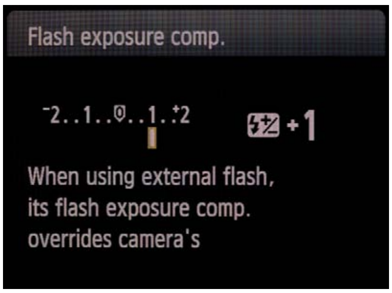
Other cameras have the ability to apply FEC via a general menu option or the flash control menu.

Many Speedlites have FEC controls on the back. On earlier models, these are the + and – buttons. Later models typically require pressing the SEL/SET button first to activate those buttons. The 580EX and 580EX II have a rotating dial instead of buttons, and a custom function determines if the SEL/SET button needs to be pressed first. The 600EX/600EX-RT and MR-14EX

II have a +/– menu option assigned to button 2. The 430EX III/430EX III-RT units have a +/– button: press it and then rotate the dial to change FEC.

9.45

9.46



9.47

When FEC is set to anything other than zero, an FEC icon appears on flash units with displays. Flash exposure compensation isn't additive on EOS bodies. In other words, if both camera body and flash unit have the ability to set FEC, and the flash unit's FEC controls are set, the flash unit takes priority and the camera's adjustments are ignored.

As noted earlier, EOS bodies will apply auto fill reduction under brighter ambient lighting conditions. So it may not be necessary to add any extra FEC in the case of fill flash, particularly when using E-TTL. (Any FEC applied manually is in addition to any auto fill reduction that the camera may apply.)

9.48 Wing of Chinese oak moth, Antheraea pernyi. Flash exposure compensation over a five-stop range: minus two, minus one, normal, plus one, plus two.

–2 –1 0

9.9.1 Micro adjustment for flash exposure

In addition to FEC, some pro cameras, starting with the EOS 1D Mark IV, support "micro adjustment" for flash exposure. This custom function allows the photographer to bias normal flash metering by up to one stop in 1/8 stop increments. It's essentially a secondary level of flash exposure compensation that can be set permanently and that alters the zero point that FEC starts from.

FE Micro adjustment, as it's referred to by Canon, is used primarily to customize a camera to suit a photographer's particular needs and style. It's also possible to compensate for very minor variations from one camera body to another for precise studio work.

9.10 Flash exposure lock (FE lock or FEL)

E-TTL-capable cameras support flash exposure (FE) lock when used with EX flash units. This feature "locks" flash exposure settings until a picture is taken, allowing an image to be recomposed after the E-TTL metering preflash has been sent. This improves flash metering in certain cases. Canon first introduced FE lock in 1986 with the T90 camera and 300TL flash, but subsequently dropped it. FE lock made its return with E-TTL in 1995.

FE lock works by firing the usual E-TTL preflash when the AEL or FEL button is pressed on the camera, rather than just before the scene-illuminating flash is fired. It then stores the flash exposure value in memory, based on a spot metering of that preflash, and waits for you to recompose the image. When you press the shutter release all the way, the camera will fire the flash at the stored power setting.

FE lock is useful for taking photos when the subject is not covered by one of the focus points, when photos contain reflective surfaces that can fool flash metering, or occasionally when the subject is moving. In the case of E-TTL (though not E-TTL II), it's also useful for scenes in which flash exposure needs to be biased to something other than the current focus point.

The main drawback with FE lock, aside from the extra button pushing, is that the manually triggered preflash can confuse human subjects who may think that a photograph has just been taken when it actually hasn't.

+1

+2

9.10.1 Engaging FE lock

On most EOS cameras, the AE (autoexposure) lock and flash exposure lock features are tied together, so pressing the * button locks both ambient and flash metering. But conveniently, most 1-series EOS cameras have separate FEL buttons that allow for setting the AE lock and FE lock independently. The EOS 10D's custom function 13-4 allows the assist button to be a dedicated FE lock, and the multi-function M-Fn button (EOS 7D, 6D, 5D Mark III, 1D X, 7D Mark II, and 5DS) can also be used for this function.

9.49 This 50D, like most non 1-series cameras, ties FEL and AE-L to the same button

9.50 Older 1D series cameras have a dedicated FEL button near the shutter release

9.51 Newer cameras, like the EOS-1D X, EOS-1D C, EOS 5DS, EOS 5DS R, and EOS 7D Mark II, have an M-fn button where the old FEL button would have been.

Whichever button is pressed, the camera stores locked flash exposure data for a 16-second period, or for as long as the shutter release is pressed halfway. It will also briefly indicate FEL in the viewfinder, top deck LCD, or rear panel LCD on some camera models; additionally, the ϟ* symbol may appear. During this time, the picture can be recomposed in the viewfinder, or the aperture and shutter speed can be altered (overriding AE lock, which is set when the AE lock button is pressed). If the flash symbol in the viewfinder blinks upon setting FE lock, then the subject is too far away to be illuminated sufficiently.

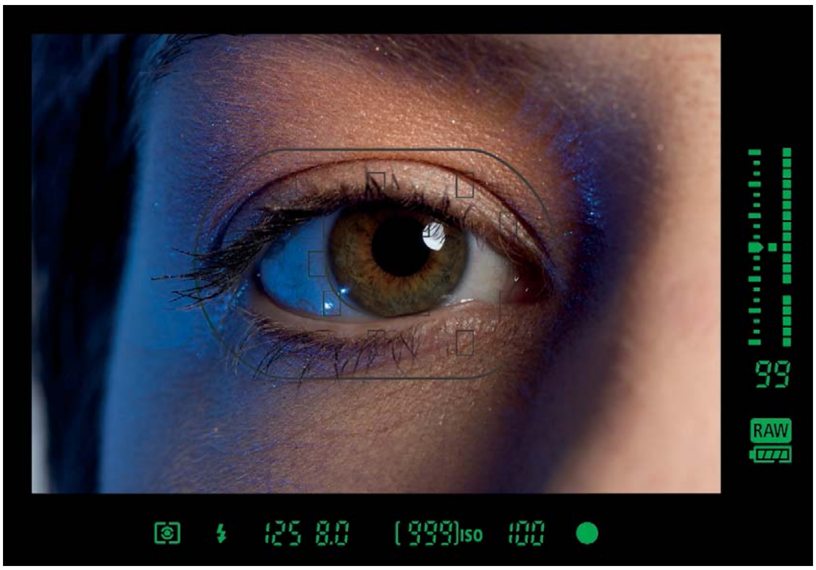
Some cameras have a custom function that specifies whether spot metering and FE lock are to be tied to the central focus point—the default—or to the active focus point instead.

FE lock is not available if the camera is in an icon mode or CA mode, or if digital Live View is enabled. Some early film models may not support FE lock if the flash unit is in high-speed sync mode. If the flash unit also supports TTL, it must be in E-TTL mode for FE lock to function.

9.10.2 Flash exposure level

Most 1-series professional Canon cameras have the ability to display the flash exposure level in the viewfinder. When the FEL or M-Fn button is pressed (the small button near the shutter release) a vertical sliding scale will appear in the viewfinder on the right side. ☐ 9.52

The flash exposure level will be displayed on the far right bar of this scale. The flash output can then be adjusted via flash exposure compensation.



9.52

9.11 Fill flash ratios

A traditional model for thinking about artificial light in photography is the ratio. In a two-light portrait, for example, a photographer might consider the ratio of the key light (the main light illuminating the photo) to the fill light (the secondary light that fills in the shadows). Ratios are used in the context of fill flash as well, and are used to describe the amount of ambient (available) light illuminating a scene compared to the amount of flash.

However, ratios aren't a very useful model for automated flash; particularly fill flash. There are a number of reasons for this. First, there are two different ways of specifying a ratio, depending on whether you're considering light output (incident light) or reflected light bouncing off a surface. Second, ratios may make some sense in a studio where it's easy to have full control over all light sources, but it's not at all straightforward when dealing with ambient light. Third, when using automated flash systems it isn't really possible for the photographer to measure the flash output. And finally, EOS cameras don't use the ratio model for specifying flash output anyway. They do unfortunately use ratios when dealing with controlling the output of wireless flash groups, but that's a different topic altogether.

The first point can lead to a lot of confusion. Does a ratio refer to the ratio of ambient light plus fill flash combined, compared to fill flash alone (effectively the reflected light that makes its way back to the camera)? Or does it simply mean the ratio of ambient light to fill flash (the incident light hitting the subject)? For example, a fill flash ratio of 1:1 can mean that the flash is the sole source of light. Or 1:1 can mean that the flash and ambient light levels are the same. These are two very different situations.

When using automatic flash metering, EOS cameras work in terms of "compensation" rather than ratios. In other words, in bright light conditions the camera will attempt to illuminate the foreground with a flash output that its designers think should work well. With experience, and judicious examination of the preview screen in the case of digital, it then becomes possible to know if this automatic setting works for you. If it doesn't, you can increase or decrease the flash output using flash exposure compensation with most cameras and flash units. This is done in terms of "stops" of output (see section 6.17).

9.12 Auto fill reduction

EOS cameras use regular flash exposure with no compensation when ambient light levels are low, i.e., 10 EV or lower (see section 7.17). However, when ambient light levels are bright, 13 EV or higher, the camera switches to fill flash mode and reduces the flash unit's output level. This feature, sometimes called "automatic reduction of flash output," works in TTL mode by dropping flash output by 1.5 stops. Between 10 and 13 EV, the camera smoothly lowers the flash unit's output by half a stop for each EV.

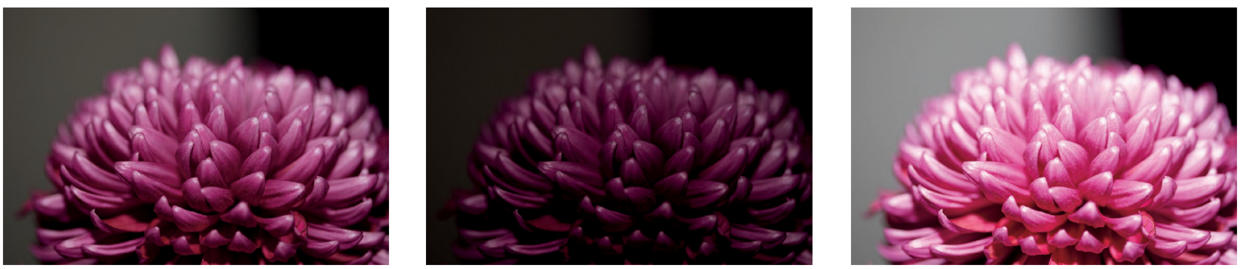
9.53 This strongly backlit photo is a great situation for automatic fill flash. Notice how E-TTL II has filled in the foreground without blowing it out badly, and without resulting in a flat cardboard cutout look.

E-TTL flash works in a similar fashion, though flash output may be lowered by as much as two stops when ambient lighting is bright. It does so in a more sophisticated fashion than TTL, since it examines each zone as lit by ambient and preflash to compensate for highly reflective areas. The E-TTL fill reduction algorithms have not been published.

Some mid- to high-end EOS cameras allow auto fill reduction to be disabled by means of a custom function (see flash exposure compensation, sections 2.2 and 6.17). Any flash compensation applied manually is in addition to this auto fill flash reduction.

9.13 Flash exposure bracketing (FEB)

The 500/600 EX series Speedlites and the three EX macro units all support flash exposure bracketing. This is similar to auto-exposure bracketing (AEB), only instead of changing ambient exposure settings the camera locks the shutter speed and aperture. Then it shoots a series of three photographs with normal flash exposure settings, positive flash compensation, and negative flash compensation. 9.54

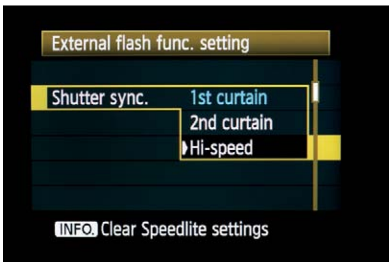


9.54 Chrysanthemum taken with flash exposure bracketing: normal, minus 1 stop, plus 1 stop.

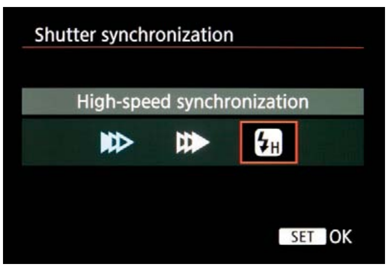
Bracketing values can be in half, third, or full stops, and the flash star icon may appear in the viewfinder during the sequence. FEB auto cancels once the three-photo sequence is complete and uses whichever drive mode the camera is in. FEB can be used together with both flash exposure lock (FE lock) and flash exposure compensation (FEC).

9.14 High-speed sync (HSS)

9.55



9.56



9.57

High-speed sync, described fully in section 7.12, is a technology that rapidly pulses a flash unit in order to surpass a camera's flash synchronization limit (X-sync). HSS flash is turned on by a switch on some flash units, by pressing the + and – buttons simultaneously on others, and by pressing a high-speed sync/second curtain sync button on yet others. On new units like the 430EX and 580EX II, pressing the HSS/second curtain button cycles through three sync choices: HSS, second curtain (if the flash unit is not in wireless mode), and normal first curtain. On most Speedlites with dot matrix screens, pressing the SYNC button (function button 4) cycles through the choices. On the 430EX III/430EX III-RT, press SEL/SET, rotate the dial until the sync icon to the left of the exposure scale is highlighted, then press SEL/SET and turn the dial to select the third sync mode, marked with an H. ☐ 9.55

High-speed sync and second curtain sync are mutually exclusive, since the former pulses the flash continuously for the duration of an exposure, whereas the latter fires the flash just once at the end of an exposure. Cameras with menu control over Speedlites (ESC) can set HSS mode by selecting "Hi-speed" or "High-speed synchronization" from the "Shutter sync" menu. ☐ 9.56 and 9.57

HSS mode is indicated by the ⚡H symbol appearing on the flash unit's LCD or by an indicator LED. The mode is confirmed by the same symbol in the viewfinder. If this symbol does not appear but HSS is engaged on the flash unit, then the shutter speed is below the camera's X-sync speed.

When the flash unit is in HSS mode, you can set a shutter speed higher than the camera's X-sync. The flash unit will revert to normal flash firing behavior if the shutter speed goes back down below X-sync. Canon Speedlites will remember the HSS mode setting and will switch back to it if the shutter speed is set beyond X-sync once more, but some third-party flash units will inconveniently cancel HSS mode if the shutter speed drops below X-sync.

HSS mode produces about half the output of normal flash, and the range decreases inversely to the shutter speed. This could be a serious impediment when using a smaller flash unit, if the subject is far away, or if using a low ISO setting. The distance range display on the flash unit can be a useful tool for evaluating whether HSS will work for you when in direct flash mode.

HSS mode is only available with EX-series flash units on type A bodies (with one exception: the EOS 1N film camera could be reprogrammed by Canon to add HSS). No EOS popup flash supports HSS. HSS is available in radio wireless mode only with radio-aware cameras released after 2012.

9.15 Enabling second curtain sync

Second curtain sync, described in section 7.13, records more natural motion trails of moving objects when using flash. Availability of the feature is entirely dependent on the specific camera/flash unit combination that's being used. Here things get a little complicated.

Physical controls on flash unit

Any Speedlite with its own physical controls can use second curtain sync with virtually any EOS camera. The type of control used depends on the model, but it is usually a button or switch marked with a triple triangle symbol or the word SYNC.

On the 430EZ and early EX models such as the 550EX, the + and – buttons must be pressed simultaneously to engage second curtain sync. On the 300EZ and 300TL, there's a small slide switch. On the 430EX, 580EX, and their Mark II versions, a button marked with the ▷▶ symbol is pressed to cycle through sync modes. Press once to engage high-speed sync (⚡H), press twice to engage second curtain sync, and press once more to return to normal first curtain sync. Most Speedlites with dot matrix screens use function button 4, marked SYNC, to cycle through to second curtain mode. On the 430EX III/430EX III-RT use the same method for enabling high-speed sync as above, only select the second curtain sync icon (second of the three icons). ☐ 9.58

Second curtain sync can't be enabled if the flash unit is in any wireless mode.

9.58

Custom functions/menu items

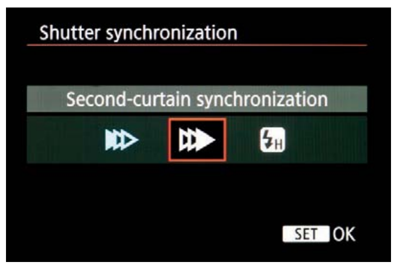
Most midrange and professional EOS bodies from the early 1990s onwards have a custom function or menu setting that enables second curtain sync. If both the camera and the flash unit have second curtain controls, then the physical switch or button *on the flash unit* takes priority. These function/menu settings default to first curtain sync.

Second curtain and external Speedlite control (ESC)

Post-2007 EOS cameras can communicate with recent Speedlites to enable a host of different flash unit settings, as detailed in section 9.30. Such cameras can control second curtain sync on compatible recent Speedlites. Select Shutter sync. and choose first or second curtain. ☐ 9.58

Unfortunately, on some camera models the "Flash control" menu item titled "External flash func. setting" cannot communicate with older flash units. Since most of these cameras lack a second curtain sync custom function, you're stuck.

In short, such cameras cannot engage second curtain sync when using older Speedlites that lack physical controls on the flash unit itself. You can only engage second curtain sync if the flash unit has physical controls, or if it's a recent model capable of full function control. See appendix C for a list of flash units and cameras that have this menu feature.



9.59

9.15.1 Second curtain limitations

Second curtain sync has a number of specific limitations. First, it can only be used in the “creative zone” modes: P, Av, Tv, M, B, DEP, and A-DEP. It can’t be enabled in any icon mode, green rectangle mode, or CA mode. Second curtain sync is also incompatible with both stroboscopic and high-speed sync modes, and it cannot be used with either optical or radio wireless E-TTL. Second curtain cannot be activated if the shutter speed is faster than about 1/60 sec. Finally, second curtain sync does not work with all-manual flash units (next section).

9.15.2 Enabling second curtain sync with manual equipment

EOS cameras only support second curtain sync when using Speedlites connected directly or via an off-camera shoe cord. When using sync-only manual flash, the camera cannot command a flash unit to fire when the shutter is about to close. This is because EOS cameras send the sync command digitally in second curtain mode, rather than simply triggering the hotshoe’s center pin. The same issue affects sync-only radio triggers (section 11.10). Accordingly, second curtain sync will not work in sync-only situations unless the flash unit or radio trigger supports its own implementation of second curtain sync (PocketWizard and Quantum, for example).

There is one workaround, though it is a little inelegant and doesn’t work with sync-only radio triggers. The trick is to use a Canon Speedlite to trigger manual gear equipped with an optical slave. For this to work, the Speedlite cannot be in E-TTL mode because the preflash will set off the slave unit too soon (section 11.7.3).

The best solution is to use a Speedlite with manual output control. Set the Speedlite to second curtain sync and put it in M mode at a low power, such as

9.60 This shot used wireless E-TTL from a 580EX master on the camera to trigger a 580EX II positioned above the model to light the falling water. However, because second curtain sync isn’t possible wirelessly, the water drops look like they’re falling upwards because the image was shot with first curtain sync.

1/64 or 1/128. This lets the flash unit send a pulse of light bright enough to trigger a nearby optical slave unit, but not bright enough to contribute much light to the scene. Even ancient EZ units can be used this way. For example, the 430EZ doesn't support E-TTL, but it can fire in manual second curtain sync mode when used with a new EOS digital camera.

9.16 Manual flash

High-end Canon flash units support full manual mode, which lets you specify the flash power by hand, rather than relying on an automated system like TTL or E-TTL. Note that manual *flash* metering is not the same thing as the *camera's* manual exposure (M) mode; the latter is used for ambient (non-flash) light metering. For more information, review chapter 10 on manual flash metering.

Flash output is specified in fractions, from 1/1 (full power) to the minimum power output setting: 1/64 or 1/128, depending on the model. Some units allow for additional sub-increments between these fractional settings. The sub-increments may be half a stop or one-third stop, and are particularly useful for the big drop in power between full power and half power.

9.61 A 430EX set to 1/4 manual power with an additional minus 1/3 stop

Speedlite 420EZ

Press the MANU button to engage manual mode. Press MANU repeatedly to cycle through the manual power output settings.

Speedlites 430EZ, 540EZ, 550EX, 430EX, 430EX II

Press the MODE button to cycle through mode settings until the letter "M" appears on the LCD. To change output, press the SEL/SET button. The output setting will start to blink. Press the + or – buttons to increase or decrease the power. Press SEL/SET to confirm the change. □ 9.61

Speedlites 430EX III, 430EX III-RT

Press the MODE button in the central group of buttons. Rotate the dial until M is selected, then press SEL/SET. To change the output level, press the +/– button in the central group, then rotate the dial until the desired level is selected. Press SEL/SET to confirm.

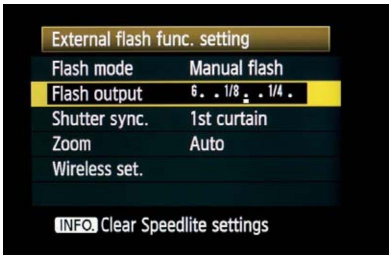
Speedlites 580EX, 580EX II

Press MODE until the M appears, then press SEL/SET. The output setting will start to blink. Rotate the dial to increase or decrease the power. Press SEL/SET to confirm the change.

Speedlites 600EX, 600EX-RT

Press MODE until M appears, then press function button 2 (+/–). The output level will appear on a scale on the LCD. Rotate the dial to increase or decrease the power. Press SEL/SET to confirm the change. □ 9.62

9.62



9.63

Flash units with menu control have sliders on the camera's LCD for adjusting manual output. Recent low-cost flash units such as the 90EX, 270EX, and 270EX II, are manual capable but only when used with an EOS camera that has menu controls built in. (They lack physical buttons for manual control.) ☐ 9.63

With digital SLRs, it's easy to adjust manual flash settings by hand and conduct some simple lighting tests. The camera's preview screen is then used to evaluate the results.

9.16.1 Manual flash calculations

Since light output falls off over distance in a predictable fashion, it's possible to perform distance calculations by hand.

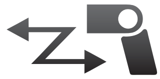
Speedlites with manual controls and rear LCD panels can perform these calculations automatically. For completeness, these are the steps to do it, though frankly this functionality is rarely used by most photographers.

- Set the camera to either Av (aperture priority) or M (manual exposure) mode. The camera can be set to other "creative" zone modes, but the aperture symbol will flash to indicate a problem and the picture's flash metering will probably be out.
- Set the flash to manual mode, as above.
- Press the shutter button halfway. The flash will display the current aperture and a distance setting.
- If the camera is in Av mode, the shutter speed will be the camera's X-sync speed and the aperture can be set manually. In M mode, the shutter speed can be any value from 30 seconds to the camera's X-sync, and the aperture can be any setting within the physical abilities of the lens.
- Adjust the settings so that the distance information on the flash matches the number on the distance scale on the lens. If the lens lacks a distance scale, then the distance will have to be estimated or measured.
- Once everything's set correctly, the shutter release can be pushed all the way to take the photo, assuming the "flash ready" lightning bolt is displayed in the viewfinder.

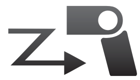
The flash unit can't perform useful calculations if the flash head is in bounce mode—the calculations must be done manually by measuring the flash-to-subject distance. In bounce mode it's not the distance from the flash to the subject that's important; it's the distance that the light actually has to travel from the flash to the reflecting surface and then to the subject. Light loss from the reflecting surface must also be factored in, which can only really be done by experience or judicious use of a flash meter. The flash unit's guide number is measured in meters and for ISO 100. Additional arithmetic is required when using feet and/or a different ISO.

9.17 Optical wireless E-TTL flash

As of 2012, there are two Canon-supported ways to control a remote Speedlite wirelessly: 1) optical (coded pulses of light or infrared) and 2) radio (radio wave transmissions). Optical is widely supported across many EX Speedlites and all type A (E-TTL compatible) cameras. Speedlites that have both optical and radio wireless capabilities use the icon to specify optical wireless.



Master unit



Slave unit

Different models have different ways of entering wireless E-TTL, a mode described in detail in section 11.8. Canon identifies wireless E-TTL controls with a Z-shaped icon. The exact configuration of this icon depends on whether the unit is a slave, master, or capable of being both.

A Z with arrows on each end refers to a unit with master/slave capabilities. A Z with an arrow pointing *towards* the flash unit icon means slave mode, and a Z with an arrow pointing *away* from the flash unit icon means master mode. The white wireless icon is not to be confused with the blue PictBridge icon on some digital cameras, which looks very similar.

Physical switches

The 420EX, 430EX, 550EX, and 580EX have a convenient physical switch at the bottom, which reads either OFF—SLAVE or OFF—MASTER—SLAVE. This switch makes it easy to move rapidly from mode to mode, which is of particular importance to news or wedding photographers who need to jump from on-camera flash to wireless flash immediately.

Confusingly, OFF means wireless optical mode off, not main power off—it should probably have been labeled SINGLE or SOLO or something less ambiguous. When the switch is in master mode, the flash unit only *sends* wireless control signals to slave units. When the switch is in slave mode, it only *receives* wireless commands. The 270EX II has a three-position switch, for OFF, SLAVE, and ON. ☐ 9.64

9.64

Pushbutton controls

The 430EX II and 580EX II, which have camera menu control over Speedlite functions, have a hidden and less convenient pushbutton control. Pressing and *holding* the ZOOM/wireless icon button for two or three seconds will cause the tiny wireless icon to blink. To change a 580EX II from master to slave mode, rotate the control dial after holding the ZOOM button. Press the SEL/SET button to confirm the choice. Pressing and holding the ZOOM button puts the 430EX II into wireless slave mode. ☐ 9-.65

9.65

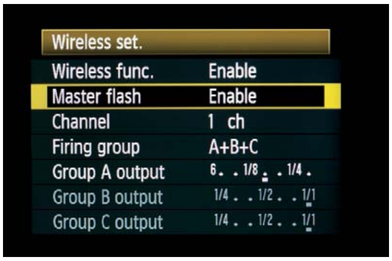
This awkward button-pushing necessity takes a moment, which can seem an eternity in fast-moving situations. The ZOOM button also controls quite a few separate features, making it easy to select something else by mistake. For those reasons, many photographers relied on switch-equipped 550EX and 580EX units as their on-camera masters until the advent of radio wireless.

9.66

Wireless button

The 600EX/600EX-RT and 430EX III/430EX III-RT have a special button marked with the symbol. Pressing this button sets the unit to optical wireless master mode when the lightning bolt ( ) and MASTER icons are displayed. Another press of the button switches the unit to radio wireless slave mode. See section 9.19 for radio wireless mode. ☐ 9.66

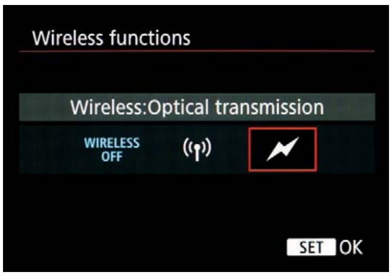
Note one confusing point: the 430EX III and 430EX III-RT can both serve as optical slaves, but *neither* can serve as optical masters. However, the 430EX III-RT can be a *radio* master or a radio slave.



9.67

Menu controls

On-camera menu controls (external Speedlite control) for enabling and controlling optical wireless are available for certain camera/Speedlite combinations (see section 9.32). The menu is a bit buried but offers a generally more intuitive interface. And for smaller flash units with virtually no physical controls, such as the 90EX and 270EX II, menu control is actually the only way to adjust flash settings. ☐ 9.67



9.68

Macro units

The MR-14EX and MT-24EX go into optical wireless mode when group C is enabled. This is done by pressing the RATIO button until CH appears (MR-14EX and MT-24EX) or the lightning symbol and MASTER (MR-14EX II).

9.69

9.17.1 Changing optical wireless E-TTL settings

Once slave or master mode is set, the user interface for changing optical wireless settings is not the easiest Canon flash feature to understand. It also varies from model to model.

On flash units with LCD panels, optical wireless master mode is indicated on the LCD by the icon or the word MASTER, with the number below CH indicating the current channel. Optical wireless slave mode is indicated by the word SLAVE, with a letter below SLAVE indicating the current group. On flash units without LCDs, groups and channels are indicated by LED lights, switch positions, or camera menu settings. ☐ 9.68

9.17.2 Changing optical channels and groups

Speedlite 420EX

There are separate buttons for changing channels and groups. Pressing each button cycles through the available settings, and an LED will illuminate to indicate the selection. The unit must be in wireless slave mode (the small switch near the flash foot) for these to work.

Speedlites 430EX and 430EX II

When the unit is in slave mode, press the ZOOM button until either CH or SLAVE starts blinking. Use the + and – buttons to select the channel or group.

Speedlites 430EX III and 430EX III-RT

Press SEL/SET, then use the dial to choose one of the four channels: shown on-screen as “Ch.” 1 through 4. Groups A, B, or C can also be chosen.

Speedlite 320EX

The 320EX has physical switches for slave mode, channels, and groups.

Speedlite 550EX

Press the SEL/SET button to cycle through a series of options: flash exposure compensation/flash exposure bracketing/ratios/channels/groups/master firing on/off. When the CH icon starts blinking, press the + or – buttons to change channels. If the flash unit is in slave mode, SEL/SET will allow the group to be selected. Pressing + or – changes the group, which is oddly marked by the SLAVE icon, not by the word GROUP.

Speedlites 580EX and 580EX II

Pressing (but not holding) the ZOOM button if the unit is in master or slave mode will cycle through a series of options. These options include: zoom setting/ratio (in master mode)/channel/master flash firing (in master mode)/group (in slave mode). If the CH or SLAVE symbols start blinking, turn the control dial to change channels or slave groups.

Macro lites MR-14EX and MT-24EX

These units can change channels for external Speedlites in group C. To do so, press the recessed CH button to cycle through the four channels. Groups A and B are always assigned to the left and right macro tubes in these units.

Speedlites 600EX/600EX-RT and ST-E3-RT

From the main menu on the Speedlite, press button 4 to bring up MENU 3. Then press it again to bring up MENU 2. Now function button 1 changes to CH for channel. Press button 1, and use the dial to choose the channel (1–4) that you want. Press SEL/SET to confirm.

Macro lite MR-14EX II

From the main menu, press button 4 to bring up MENU *. Function button 1 will change to CH for channel. Press button 1, and use the dial to choose the channel (1–4) that you want. Press SEL/SET to confirm.

Speedlites 90EX and 270EX II

These tiny units lack physical controls to speak of, and must be configured through the camera’s ESC menu.

9.17.3 Enabling and changing ratios

Optical wireless E-TTL slaves can be in one of three groups, and it's possible to change the relative output levels of each group. Changing output ratios between the three slave groups is rather confusing and non-intuitive: the relationship between groups A and B is a ratio, whereas group C has an exposure compensation (+/–) relationship to groups A and B when taken as a unit.

Optical wireless is structured this way because it assumes a specific lighting model: groups A and B are the key and fill lights, with C being a background highlight. Radio wireless E-TTL has a more flexible five-group system.

Enabling ratios

On the 550EX, make sure the unit is in master mode, then press the SEL/SET button repeatedly and cycle through the choices (flash exposure compensation/flash exposure bracketing/ratio/channel/master firing) until RATIO starts blinking. Press +/– to select A:B ratios, A:B C ratios, or no ratios (OFF).

The 580EX and 580EX II have similar controls, only the ZOOM button, not SEL/SET, cycles through the modes (zoom/channel/master firing/ratio). Once "RATIO" starts blinking, rotate the control dial to enable or disable the three settings—RATIO A:B, RATIO A:B:C, and RATIO: OFF.

9.70 Ratio slider

The MR-14EX and MT-24EX are actually a lot easier to use, since they have dedicated "RATIO" buttons. Pressing this button once enables A:B (tube left and tube right), and pressing it again enables A:B C (tube left, tube right, and external Speedlite). Pressing it a third time reverts the unit to both tubes and no external Speedlite firing.

On the 600EX/600EX-RT, press function button 4 to get MENU 2 to appear. Then press function button 2, and choose RATIO A:B or RATIO A:B C as required. The 430EX III and 430EX III-RT cannot serve as optical wireless masters.

Changing A:B ratios

Once ratios are enabled on the 550EX, press the SEL/SET button repeatedly to cycle through the choices until both RATIO and the mark on the A:B slider start to blink (i.e., it isn't possible to adjust the actual ratio setting until the mark itself starts blinking).

On the 580EX or 580EX II, enable ratios as above. Then press the SEL/SET button repeatedly to cycle through the choices: flash exposure compensation/flash exposure bracketing/A:B ratio/C compensation.

Once the small *mark* on the slider starts blinking, it is possible to adjust the A:B ratio on the horizontal output A:B display, ranging from a ratio of 8:1 to 1:1 to 1:8. Use the + or – buttons or the dial to move the mark position, indicating the ratio of A to B output. □ 9.70

Again, the MR-14EX and MT-24EX are much easier to use, as they have ratio adjustment buttons in addition to a RATIO button. Once the ratio slider is on-screen, simply press the < and > buttons to adjust the slider mark.

On the MR-14EX II, press the RATIO button to enable A:B ratios. To change the A:B ratio, press function button 3 (Gr) and then use the dial. SEL/SET to confirm. You can also press the RATIO button to cycle through the A tube only on, or the B tube only. ☐ 9.71

See the steps above for enabling A:B ratios on the 600EX/600EX-RT. Press function button 3 for Gr (group) functions. Press function button 3 for A:B +/–, and then use the dial to set the ratio of A to B slaves. Press function button 4 (↩) to exit the menu system.

9.71

Changing C compensation

Make sure that the "RATIO" choice is set to A:B C to enable all three groups.

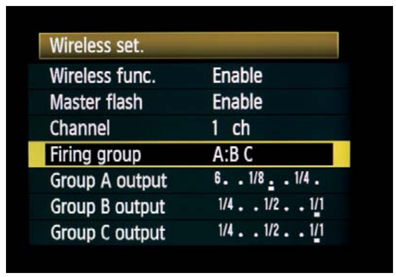
On 500 series units, press SEL/SET repeatedly and cycle through the choices until "RATIO C" starts blinking. It is then possible to specify the number of stops of compensation for the C group relative to A and B, from –3 to 0 to +3 stops. This is done either by pressing the + and – buttons on the 550EX or rotating the dial on the 580EX or 580EX II.

On the MR-14EX or MT-24EX, use the + and – buttons to add or subtract group C compensation. To get this function once ratios are enabled, press SEL/SET repeatedly to cycle through the choices until "RATIO C" starts blinking.

On the MR-14EX II ring lite, use custom function 15 to enable slave group C support if necessary. Press the RATIO button to display RATIO A:B C. Make sure the channels are correct for master and slave.

See the steps above for enabling A:B C ratios on the 600EX/600EX-RT. Press function button 3 for Gr (group) functions and select group C. Press function button 3 for C +/–, and then use the dial to set the ratio of A to B slaves. Press function button 4 (↩) to exit the menu system.

On the 430EX III/430EX III-RT, set "A:B C" using the method above, and then use the dial to select the amount of flash exposure compensation for channel C.



9.72

External Speedlite control (ESC)

If your camera and Speedlite combination has ESC for flash menu control (section 9.30), you can set flash ratios in a much more intuitive fashion by using the on-camera menus. Somewhat confusingly, the in-camera menu control may describe no ratios as RATIO A+B+C (i.e., all slave groups have the same output level). ☐ 9.73

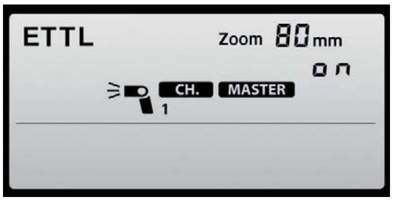
9.73

9.17.4 Specifying optical wireless flash output manually

In addition to automatic ratios, wireless E-TTL allows manual flash output power to be set for the three groups separately on all 500 and 600 series EX units.

To do so, press the master flash unit's MODE button until M is displayed. Then enable RATIOs as above. When the flash unit is in wireless mode but with manual metering, the RATIO function allows each of the three lettered flash groups to have its output set manually. This is set from 1/1 (full power) to 1/128, though unfortunately only in full stop increments. The group being set will have its letter underlined. When output power is set by hand, no automatic flash metering is performed.

Individual slave units can also be set to manual mode. The key is to switch the flash unit to slave mode, then press and *hold* the MODE button until M appears. It's even possible to set a wireless slave to MULTI (stroboscopic) mode this way; additionally, 1/2 or 1/3 stop increments are possible on slave units.



9.74

9.17.5 Master flash firing on/off

Some master units can be instructed not to fire (i.e., not to contribute any scene-illuminating light) while still controlling remote slave units. While the master unit won't contribute any light to the scene when off, it will still fire a visible preflash to command the slave units in optical wireless mode.

On the 550EX, press the SEL/SET button repeatedly and cycle through the options until flash on/off is selected. This is indicated by a blinking icon showing the flash unit emitting light. Press the +/– buttons to change this setting to ON or OFF.

On the 580EX/580EX II, press the ZOOM/ button while the unit is in master mode. The word ON and the tiny "flash emitting light" icon should blink on the screen. Turn the control dial so that the word OFF (it looks a bit like "0 FF" on the 580EX) blinks instead. 9.74

On the 600EX/600EX-RT, press function button 4 to bring up MENU 2. Then you can press function button 1 to turn master flash firing on ( ) or off ( ). 9.75

9.75

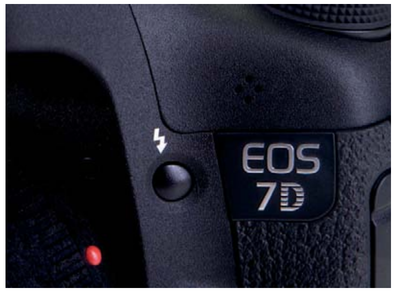
9.18 Integrated Speedlite transmitter: using built-in flash as master

No EOS camera built before 2009 could use its popup flash to command slave flash units. Since then, the 7D, 60D, 70D, 7D Mark II, Rebel T3i/600D, Rebel T4i/650D, and Rebel T5i/700D, have "integrated Speedlite transmitter" capabilities and can send optical wireless commands by pulsing the built-in flash unit. No additional master flash unit is required, which is very convenient. You can, for example, carry around tiny slave-capable flash units like the 270EX II for full off-camera wireless flash. 9.76

9.76

9.18.1 Built-in flash to control one group of slave units

- Turn on the camera's built-in flash by pressing the popup flash button next to the lens mount. □ 9.77
- Turn on the camera's menu system and select Flash Control.
- Make sure that Flash firing is set to Enable. If it's not, optical wireless E-TTL won't work. □ 9.78
- Select the "Built-in flash func. setting" menu.
- Make sure that Flash mode is set to E-TTL II. It can be set to Manual, if all-manual optical wireless flash is desired, but optical wireless will not work in MULTI (stroboscopic) mode. □ 9.79
- Select the Wireless func. menu item and set it to . This option will fire remote optical slave Speedlites, but the built-in flash unit will not contribute light to the scene. □ 9.80
- Choose the desired channel from 1 to 4 using the Channel menu item. All slaves have to be on the same channel.
- Turn on the slave units and position them as required.
- Press the button to fire a test flash.
- Take the photograph.



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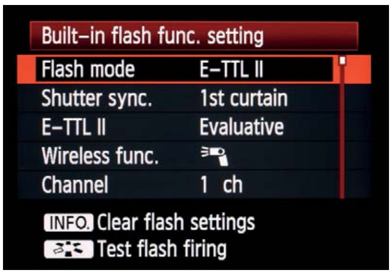
9.78



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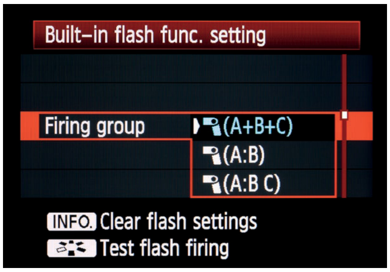
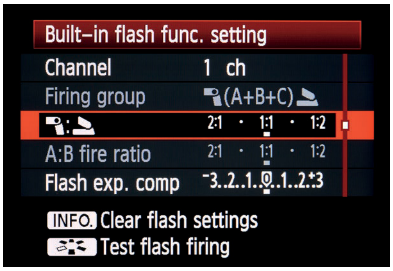
9.80

9.18.2 Built-in flash and ratios

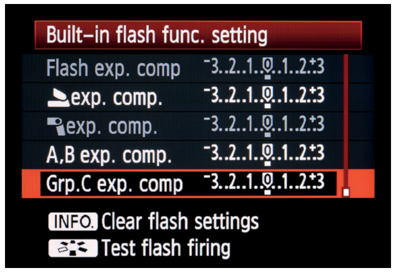
- The cameras have full ratio support, using the traditional A:B ratio with a separate group C.
- Enable optical wireless E-TTL as above.
- Choose the desired ratio type from the firing group menu item. □ 9.81
- If the firing group is set to A+B+C, then all optical slave units will fire simultaneously regardless of which group they happen to be in, so long as they're on the same channel.
- If the firing group is set to A:B, then a ratio between optical slaves in groups A and B can be set using a slider named "A:B fire ratio." When the marker on the slider is to the left side (e.g., 4:1), then group A will be brighter. If the marker is to the right (e.g., 1:4), then group B will be brighter. □ 9.82
- If firing group is set to A:B C, then exposure compensation can be applied to group C as well. □ 9.83



9.81



9.82



9.83

9.18.3 Enabling built-in flash to light the scene

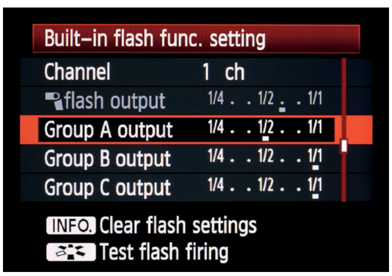
The popup flash unit can be set to light the scene as well as to act as a wireless master. However, this isn't very useful.

When the built-in flash is firing wireless E-TTL commands off to the slave units, it's obviously depleting its capacitor. Since there isn't enough time to recharge the capacitor between issuing wireless commands and the scene-illuminating pulse, there will be considerably less power available to the built-in flash unit. The maximum guide number will drop from 12 to about 4. This limits the built-in flash to adding a catchlight to the subject's eyes or a similar function.

- To allow the built-in flash to contribute light to the scene, choose the appropriate option from the "Wireless func." menu. It's possible to select for slave Speedlites only, or two options, including the icon, indicating built-in flash.

9.18.4 Wireless all-manual flash

- If "Flash mode" is set to Manual, then the camera is capable of using full manual output control for up to three groups of slave units. E-TTL metering is not used.
- If Wireless func" is set to just , then all remote slaves will fire at the same power.
- The output power is set via the "flash output" slider. Output values can range from 1/1 (full power) all the way to 1/128. The actual output setting depends on the physical capabilities of the slave unit in question—not all Speedlites can go all the way to 1/128.
- If Wireless func. is set to **(A,B,C)** then up to three separate groups of slave units can be used. The output of each group is adjustable using three flash output sliders. ☐ 9.84
- If Wireless func. is set to , then the output of all slaves can be set as one group. The output of the camera's popup flash unit can also be set independently.
- Finally, if Wireless func. is set to **(A,B,C)**, then the output of each of the slave groups and the output of the camera's popup flash unit can be set independently.



9.84

9.19 Radio wireless E-TTL flash

Wireless E-TTL flash took a big step forward with the introduction of Canon's radio-based system. At time of writing, three RT (radio) Canon flash models exist—the Speedlite 600EX-RT, the ST-E3-RT transmitter, and the Speedlite 430EX III-RT—but the system will undoubtedly be expanded in the future. The ((•)) symbol is used to indicate radio wireless. You can't use both optical wireless and radio wireless simultaneously: the technologies are independent and completely incompatible. If you've got one flash unit that's optical only, and another that supports both radio and optical, you'll have to switch the latter over to optical mode to use both units.

9.85 The 600EX-RT supports a wide range of advanced features, such as mixing and matching metering methods when using wireless.

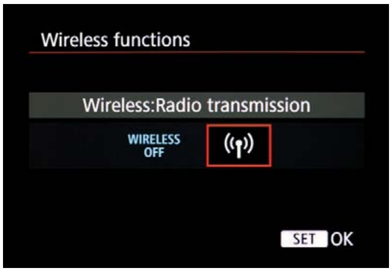
9.86 A Speedlite Transmitter ST-E3-RT attached to an EOS 5DS camera. This device lets the camera control remote Speedlite flash units over radio waves.

Pushbutton controls

The easiest way to enable radio mode on the 600EX-RT is to press the wireless (⇆) button until ((•)) appears on-screen along with MASTER. If you want to use the flash unit as a slave remote, press the wireless button again to get SLAVE on the screen.

The ST-E3-RT is always a radio wireless master unit and should be displaying MASTER unless the device has been put into LINKED SHOT mode. Next, press the MODE button to show ETTL on the display.

On the 430EX III-RT, press the wireless (⇆) button to the left of SEL/SET, and then turn the dial until the radio master symbol (((•))) is displayed. (Note that the 430EX III-RT has both master and slave radio capabilities, but can only act as an optical slave, not an optical master.)



9.87

Camera menu controls

When used with an ESC-compatible (see section 9.30) and radio-aware (see section 11.11.3) camera, it's also possible to enable a 600EX-RT or 430EX III-RT's radio mode using a camera's Speedlite menus. This option is not available to EOS cameras made prior to 2012. ☐ 9.87

9.19.1 Changing radio transmission channels

The next step is to select a wireless channel. Unlike optical wireless channels, these are true radio-frequency channels representing 15 different sections of the 2.4 GHz band. All master and slave units must be on the same channel for them to work together.

On either the 600EX-RT or the ST-R3-ET, press function button 4 to bring up MENU 3. Then press function button 1, labeled CH. You can then turn the dial to select any channel you want from 1 through 15. Or, if you'd like the flash unit to choose one for you, select AUTO. Then press SEL/SET to confirm your choice. Press function button 4 (the return arrow symbol) to go back to shooting mode.

On the 430EX III-RT, press SEL/SET and rotate the dial until either AUTO or a numbered channel is highlighted on the screen. Press SEL/SET again to choose the channel you want, then SEL/SET to confirm.

Naturally, cameras with ESC menu control can enable channel selection as well.

9.88

9.19.2 Scanning for a radio transmission channel

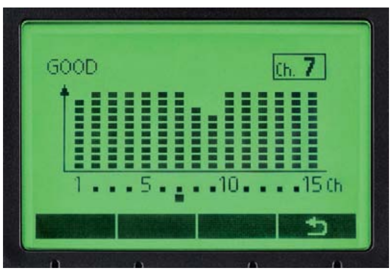
Which channel to use? It's important to select a channel that minimizes interference from other devices transmitting in the 2.4 GHz range. All kinds of products use this band—phones, laptops, tablets, baby monitors, radio-controlled toys, and home automation systems—so it can get pretty congested. RT Speedlites have both automatic and manual channel scanning for detecting available channels. On the 600EX-RT or ST-E3-RT, press function button 4 to bring up MENU 3. Then press function button 3, SCAN. On the 430EX III-RT, press SUB MENU and then use the dial to select SCAN. ☐ 9.89

If your RT unit is currently set to channel AUTO, then SCAN will examine each of the 15 channels and select the channel with the least number of competing devices.

If your RT unit is set to a manual channel, then SCAN will bring up a histogram showing the suitability of each channel. Select the channel with the highest bar using the dial, then press SEL/SET. ☐ 9.90

All master and slave units must be on the same channel to work correctly.

9.89



9.90

9.19.3 Wireless radio ID

One extremely handy radio wireless E-TTL feature is that each master/slave configuration can have its own unique four-digit “radio ID” code. This greatly lowers the chances of other people’s flash units within radio range interfering with yours, since there are 10,000 codes to choose from. Just don’t choose anything obvious like 0000 (the default), 1234, or 9999!

On the 600EX-RT or ST-E3-RT, press function button 4 to bring up MENU 3. Then press function button 2, labeled ID. Now you can enter a four-digit code of your choosing. Select a digit using the dial, then press SEL/SET. Use the dial to change the number, then SEL/SET to confirm. Once your 4 digit code is in place, press function button 4 (⮌). Remember that the master and all slave units must have the same radio ID.

On the 430EX III-RT, press SEL/SET, then rotate the dial until the four-digit number in the lower left corner of the screen is highlighted. Press SEL/SET, then use the dial to change each of the 4 digits as required. Select “OK” on screen when you’re satisfied.

As always, ESC-equipped cameras can set the radio ID via an in-camera menu.

9.91

9.19.4 The LINK light

Radio-capable flash units have an LED, marked LINK, on the back. This light reports on the following situations:

- Steady green: Master and slave units are successfully connected.
- Steady orange: Unit is a master connected to a slave or slaves, but wasn’t the first one to be turned on. It’s therefore a sub-master (see 9.19.5).
- Steady red: No master/slave communication. Perhaps the slave is out of range, or the channel and ID settings are wrong.
- Blinking red: Either there are more than 16 units in total on the same channel and radio ID, or an unspecified error has occurred. For the latter, try turning the power off and then on again.

9.92

9.19.5 Multiple masters

When using radio wireless you can use more than one master flash unit. This means you can have, say, two separate cameras, each with their own master flash units attached, controlling the same set of slaves. As long as everything is set to the same channel and radio ID, it all works together.

The first master unit to be turned on and used will have a green link light. Subsequent masters (sub-masters) will have a steady orange link light. Note that there is a limit of 16 devices in total, including all the masters and all the slaves.

9.19.6 Two and three groups and ratios (traditional)

Radio wireless E-TTL can use the same two-group (A:B) or three-group (A:B C) systems used by optical wireless by setting the master flash to ETTL mode. In fact, if your camera is radio-compatible but not radio-aware (see section 11.11.3), then this is the only option you'll have for controlling the light output of more than one flash unit when using radio wireless.

The procedure for setting three-group ratios is essentially the same as with optical wireless. However, unlike optical's unlimited number of slaves, you can have up to 15 slaves in radio wireless mode.

Configuring a master unit for two or three groups

9.93

On the 600EX-RT or ST-E3-RT, press the MODE button and set ETTL. Then press function button 4 to go to MENU 2. Press function button 2, RATIO, and select either RATIO A:B for two slave groups, or RATIO A:B C for three slave groups.

On the 430EX III-RT, press SEL/SET, then rotate until the firing group symbol is highlighted. This is located between the channel/ID section and the exposure compensation slider. Turn the dial to select between ALL (no ratios), A:B (ratio between two groups) and A:B C (two group ratio and group C exposure compensation).

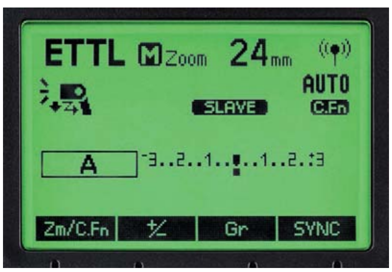
Configuring ratios for two-group radio wireless

On a 600EX-RT or ST-E3-RT master unit, press function button 3, (Gr) while MENU 1 is displayed. Then press function button 3 again for A:B +/–. Rotate the dial to change the ratio between A and B, and press SEL/SET. Press function button 4 (↩) to return the flash unit to the shooting state.

Configuring ratios for three-group radio wireless

Follow the procedure above on a 600EX-RT or ST-E3-RT. To apply flash exposure compensation for group C, press function button 3 (Gr) and select C. Then press function button 3 again for C +/– and apply compensation as required. Press function button 4 (↩) to return.

Configuring slave units



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On a 600EX-RT, press the MODE button. Then, when in MENU 1, press function button 3 (Gr) and select group A, B, or C as appropriate.

On a 430EX III-RT, press SEL/SET, then rotate until the firing group symbol is highlighted. This is located between the channel/ID section and the exposure compensation slider. Then choose the group you want the slave unit to respond to: A, B, C, D, or E.

Note that if you set the slave to either D or E then the slave unit will not respond to any master unit that's in three-group mode. Only a master unit set to group (Gr) mode will be able to command a slave unit that is set to groups D or E.

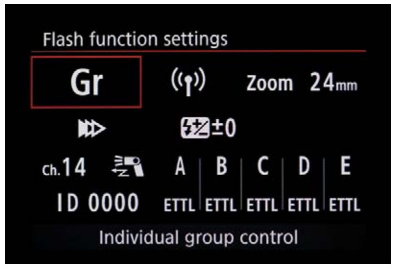
9.19.7 Manual flash in three-group mode.

You can manually control up to three groups of slaves, and manually dial in the output setting for each group. To do so, set the mode to M on the master unit. When MENU 1 is on-screen, press function button 2 (RATIO) and choose either RATIO OFF (fire all slave units regardless of group), RATIO A:B, OR RATIO A:B:C. Then you can press function button 3 (Gr) and choose the group you want to change using the control dial. For each group press function button 3 (*+/–) and use the control dial to specify the fraction of full power that you want the slave group to use.

9.19.8 Five group (Gr mode) control

Radio wireless E-TTL also introduces five-group control (A/B/C/D/E), but this feature is only available if your camera is a radio-aware model introduced in 2012 or later. Older radio-compatible cameras are limited to the traditional A:B C group (optical E-TTL) model.

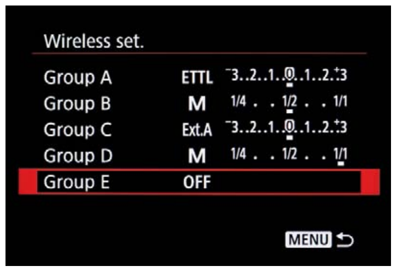
When in five-group mode it's possible to assign different metering methods to each of the separate groups. So you could, for example, have group A metering with E-TTL, group B metering manual, and group C using Ext.A autoflash if you wanted. Don't forget that each slave unit needs to be set to respond to the correct group, from A through E. □ 9.95



9.95

Configuring the 600EX-RT or ST-E3-RT as a five-group master

To enable five-group mode on a 600EX-RT or ST-E3-RT, set the master unit to Gr mode by pressing the MODE button. (Though somewhat confusingly, ETTL mode means groups 2–3 only.) Then configure each of the slave groups. Starting in MENU 1, press function button 3 (Gr) and select the group (A through E) that you want to change. □ 9.96



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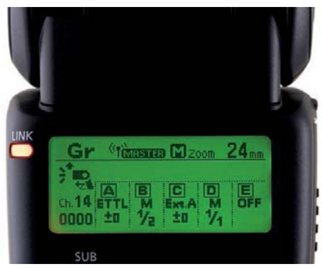
Once that's done, from MENU 1 press function button 3 (Gr) and select each group. Press function button 2 (* MODE) to determine if you want the group in question to fire as an E-TTL (ETTL), manual (M) or autoflash (Ext.A) device.

With a given group selected (marked with a black bar) you can press function button 3 (*+/–) and then the control dial to apply the amount of flash exposure compensation (ETTL and Ext.A modes) or raw flash output (M mode) you want. You can also apply flash exposure compensation to all groups at once by pressing function button 2 (+/–) from within MENU 1. □ 9.97



9.97

Configuring the 600EX-RT as a five-group master

To enable five group mode, press the MODE button and then choose Gr using the dial. Press SEL/SET to confirm.

Now you can go through the five groups (A through E) and configure each one the way you want. Press SEL/SET, then rotate the dial to choose the desired group from the lower right section of the screen. Press SEL/SET again to choose a group.

Use the dial and SEL/SET to choose which flash mode you want each group to use – ETTL, M, Ext.A. Use the dial to apply however much raw output (M mode) or exposure compensation (other modes) you require. Note that the 430EX III-RT doesn't support Ext.A mode as a slave unit, and will not fire if the master unit commands the use of Ext.A mode.

9.19.9 Test flash from a slave unit

Since radio wireless E-TTL is bidirectional, you can walk up to a slave unit on the studio floor and use it to trigger a test flash if you wish.

On a 600EX-RT slave unit, press function button 4 to bring up MENU 2. Then press function button 3, TEST, to fire a test shot. Or if you prefer, and if your camera is a radio-aware model, press function button 2 (MODEL) to enable a burst of pulsing light as modeling flash. In the case of multiple masters, only the green master unit will respond.

On a 430EX III-RT slave unit, press SEL/SET and then use the dial to choose MODEL or TEST as required.

9.20 Advanced M (metered manual) ambient metering

In a camera's manual exposure mode, the aperture and shutter speed are both set by the photographer, and these exposure settings combine with the camera's ISO or film speed to determine how the photograph, as lit by ambient lighting, is exposed. But just because you're metering manually for ambient light doesn't mean you can't use flash as well. Flash can still work fully automatically if you wish, using TTL or E-TTL as appropriate.

This is how flash works in manual mode. Note that this means the manual exposure mode setting only, which can use automatic TTL flash metering (it will not use A-TTL metering in manual exposure mode). Also, it doesn't refer to setting the output of the flash manually—that's manual flash and a different topic altogether.

- Set the camera to M for manual exposure mode.
- Set the aperture and shutter speed to expose the background correctly.
- Press the shutter button down halfway if the flash unit has a rear-panel LCD, and the flash coupling range will appear. This range is the distance that can safely be covered by the flash. Note that this only works with direct flash. The coupling range is not calculated when using bounce flash, and the range probably won't be correct if there's a diffuser on the flash head.
- If the lens has a distance scale, check the current focusing distance to ensure that the distance to the subject falls within this range. Otherwise an estimate is needed.
- If the "flash ready" lightning bolt symbol appears in the viewfinder, press the shutter all the way to take the photo. The flash's TTL or E-TTL system will determine the flash exposure level of the subject.

9.20.1 Meters and feet

Measurement systems are only used for calculating manual flash ranges, but obviously feet or meters must be available. The 430EZ was sold in two versions: one in feet for the U.S. market and one in meters for the rest of the world. The distance unit types can't be altered.

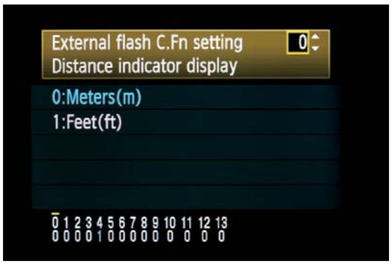
The 540EZ and 550EX can display the coupling range in either feet or meters, as determined by a tiny switch in the battery compartment. ☐ 9.98

0.5	0.7	1	1.5	2	3	4	6	9	13	18	m
1.7	2.3	4	5	7	10	15	20	30	40	60	ft

9.98

The 580EX has a hidden unit-changing feature: press and hold the C.Fn button until "C.Fn" appears on the LCD, then press and hold the center dial button until the units blink on the screen. Use the dial to change units.

The 430EX II, 430EX III/430EX III-RT, 580EX II, and 600EX/600EX-ST change measurement systems through the custom function 0, which is also accessible via the menu system on compatible cameras.



9.99

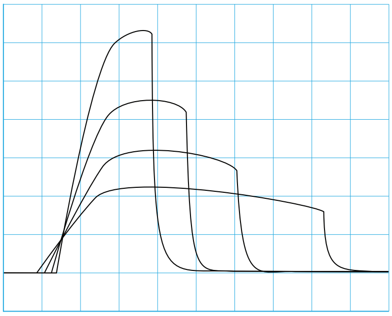
9.100

9.21 Quick Flash/Rapid-fire mode

Electronic flash units work by charging up a capacitor with electricity, then releasing the stored-up power in a split-second burst of light. The charging process, or "recycle time," takes up to a few seconds on larger units. This can be a problem if several flash photos have to be taken in fairly rapid succession, such as at a wedding.

Many EOS flash units have the ability to be triggered even if not fully recharged, on the theory that it's better to take a photo without a full flash charge than have the flash not fire at all. Flash units capable of this feature have a two-color flash ready ("pilot") light. If the light is red, then the flash is fully charged. If it's green, then the flash is only partially charged but will still fire anyway. The feature is known as Quick Flash or Rapid-fire, depending on when the model was made.

9.101



Flash duration changing with charge

9.102 This graph shows how a Speedlite will stretch out the flash duration to make up for decreased charge. The example here is at 1/8 power output.

9.103

Quick Flash is quite useful. Without it, it's all too easy to take two photos in succession only to find that the flash unit didn't fire on the second shot.

If a flash unit is fired when not fully charged, it will attempt to lengthen the time period over which the flash pulse is emitted in order to compensate for the lowered output. If this can't be done then its light output will be lower than expected.

Quick Flash won't work if the camera is in continuous shot mode (unless the flash unit has a custom function permitting this to work). It also won't work if the flash is in manual mode at full or half power, in FEB mode, or if the camera is in stroboscopic flash mode at a fairly fast setting. The 430EZ does not work in rapid-fire mode if an external battery pack is used. The MR-14EX III, 430EX III, and 430EX III-RT also have a CHARGE progress bar that animates to show the capacitor charging up. ☐ 9.103

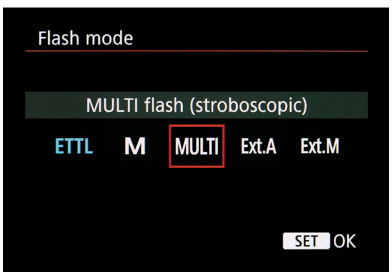
9.22 Stroboscopic (MULTI) flash

In "stroboscopic" or "MULTI" mode a 400 EZ series or 500/600 series flash unit can emit brief rapid pulses of light over the course of an exposure. This permits multiple moments of motion to be captured on a single frame. This type of photography is detailed in section 15.8.

To engage stroboscopy, press the flash unit's MODE button and cycle through the choices until MULTI is displayed on the LCD. This mode can be used on a wireless E-TTL slave unit; the key is to press and hold the MODE button if the unit is performing as a wireless slave. It can also be set using ESC on a compatible camera.

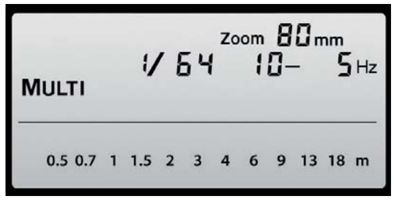
There are a number of parameters that can be set by pressing either the SEL/SET or MULTI buttons, and then pressing the + or – buttons or rotating the input dial, depending on the model. The settings are as follows:

- The frequency of flashes to be fired per second, specified in Hertz, abbreviated to Hz. 20 Hz means, for instance, that 20 separate pulses of light will fire per second.



9.104

- The power output of each burst as a fraction of full power. 1/4 power cannot be exceeded in stroboscopic mode because of the risk of the flash head overheating.
- 500/600 series units can specify the total number of flash bursts to be fired within pre-programmed safety limits. On a 400 series unit the number of bursts must be calculated by hand from the shutter time and the flash frequency. ☐ 9.105



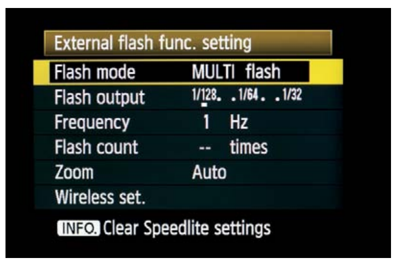
9.105

When using a 500/600 series flash unit, the coupling range on the back panel LCD will change as the camera's aperture is adjusted. Adjust the flash unit's power output, the lens aperture, and the camera's ISO (if using digital) so that the coupling range matches the distance to the subject.

9.106 A backlit shot. The model raised her arms slowly as the flash unit pulsed light at 5 Hz.

It takes experimentation to determine the ideal number of light pulses to cover the action and the output settings required to expose the subject correctly. Shutter times in seconds can be calculated by taking the total number of flashes and dividing them by the flash frequency. See the final chapter of this book for stroboscopic examples.

Consult the flash unit's manual for a table of the total number of flash bursts possible at each frequency/power setting, since each model has different capabilities. For instance at 1 Hz, most 500 models will fire 7 consecutive bursts at 1/4 power, but 100 at 1/128 power. If the number is set to – –, then the flash unit will fire continuously up to its preset limit, which again



9.107

varies by model. Note that the 580EX and 580EX II have more conservative restrictions than the 540EZ and 550EX in this regard. The safety limits are there to minimize the risk of damage to the flash head from overheating caused by firing too many stroboscopic sequences in a row.

The EOS 7D can perform stroboscopic flash using its popup flash unit, but this isn't at all useful due to the low power output of the internal flash.

9.23 Flash exposure confirmation LED

9.108

Not to be confused with flash exposure compensation, a confirmation light is an LED on the back of many Speedlite flash units. On some units it's labeled "Auto Check," though on most it's not labeled at all. It illuminates for two or three seconds, post-exposure, to confirm that there was sufficient light from the flash to illuminate the subject. Unfortunately, EOS cameras do not have such an indicator in their viewfinders.

The green LED will glow even if the image was overexposed, so it's not a guarantee of good exposure. It only indicates that the photo was not underexposed due to being out of range. 9.108

9.24 Range warning

The earliest EOS film bodies (630, 1, RT) could blink the shutter speed and/or aperture values in the viewfinder if the foreground subject was too close to or too far to be illuminated by flash. All other models lack this warning for patent reasons.

The FE lock feature with type A bodies also has a range warning. If the lightning bolt in the viewfinder blinks when the FE lock button is pressed, then there isn't enough flash output to illuminate the subject correctly.

9.25 Modeling flash

9.109

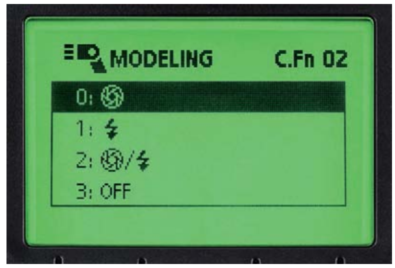
Large studio flash units usually have incandescent bulbs or white LEDs alongside the main flash tube (section 13.2.2). These constant light sources illuminate the subject in much the same way as the actual flash will, only much more dimly. The feature is known as a modeling light, since it allows the effect of the flash to be previewed in a rough fashion. Flash shadows and reflections can be determined in this way.

Canon Speedlite modeling flash simulates the effect of the flash going off before the picture is taken—particularly useful for previewing wireless E-TTL flash ratios. It works by pulsing the flash rapidly (about 70 Hz) for a second, much like high-speed sync mode. This obviously drains the batteries and can overheat the flash unit if triggered repeatedly, so it's best used sparingly. 9.109

Pressing the camera's depth of field preview button fires the modeling flash, though this can be turned off with a custom function if it's inconvenient. Some units must be in wireless slave mode for the modeling light to work, and some can trigger modeling flash using the test button on the flash unit. Both a camera and a flash unit that can support modeling flash are needed to use the feature, and the camera must be in a creative zone (letter) mode. Modeling flash won't fire if the camera is in an icon mode or if a digital camera has Live View enabled. It also doesn't work if the flash unit is in radio wireless E-TTL mode and the camera is not radio aware. ☐ 9.110

On most cameras that have it, the depth of field button is a small, unmarked button next to the lens mount, positioned immediately below the lens release button (i.e., on the left side of the camera body when looking through the viewfinder). However, for some mysterious reason, the button is located on the opposite side of the lens mount on EOS 1 series cameras. ☐ 9.111

Canon's ring flash units use small white incandescent bulbs or LEDs for focus assist and modeling purposes, not the pulsing of a flash tube.



9.110

9.111

9.26 Auto Power Off/Save Energy (SE) mode

Most Speedlites turn themselves off (also referred to as "Save Energy" or "Energy Conservation Control") after a set period of time, usually 90 seconds or five minutes, in order to minimize battery drain. Some flash units are always in this mode when powered on.

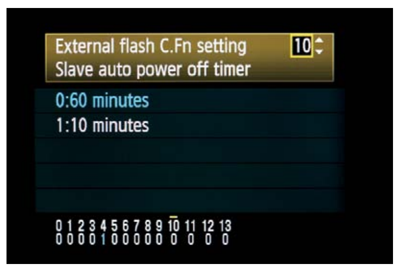
However, since it can be annoying to have a flash unit turn itself off in the middle of setting up a shot, SE override control is very important for wireless flash. Accordingly, some Speedlites such as the 550EX have a three-position switch (shown here): off, on, and SE. ☐ 9.112

Other units, such as the 600EX/600EX II and the 430EX III/430EX III-RT, use custom function 1 to enable save energy mode.

Additionally, models like the 580EX have custom functions (section 9.29) that extend the time before SE renders the flash quiescent. Other models have a longer timeout period if in E-TTL slave mode.

Pressing the flash unit's test button or the camera's shutter release button halfway will wake up the flash and recharge it. When using an N-3 equipped EOS camera with the TC-80N3 timer/remote controller, the intervalometer on an EOS 10/10s, a 600-series camera with the Technical Back E, or an EOS 1 or 1N with the Command Back E1, the camera will wake up the flash unit a minute or so prior to taking a photo in order to give it time to recharge. ☐ 9.113

9.112



9.113 Auto power off menu

9.27 Speedlite autoflash/External flash metering

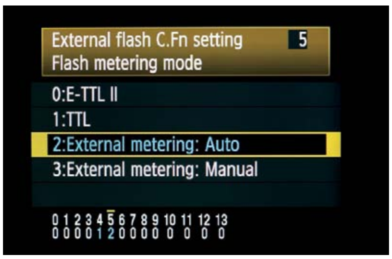
9.114 The autoflash sensor is the small round opening on the front of the 580EX II's AF assist panel. It has a coverage angle of approximately 20°.

As discussed in section 5.8.2, autoflash is a form of flash metering that predates through the lens (TTL) flash metering. The flash unit has a sensor on the front that detects the amount of light reflecting back from the scene being photographed and uses that information to control flash output.

Though seemingly very primitive—it's easily fooled and incapable of distinguishing between a reflective object nearby and a highly reflective object farther away—autoflash can be quite reliable when used properly. Note that "autoflash" sometimes refers generically to any form of automatic flash metering, but this book uses the term to mean *automatic flash metering performed by the flash unit itself, and not by the camera*.

Most Canon Speedlites don't support autoflash, with the 480EG, 580EX II, and 600EX/600EX-RT being exceptions. Autoflash only works on the film-era 480EG if the camera is connected to the flash unit via its PC connector (SYNC socket). The 480EG always uses TTL if the flash is connected via the six-pin hotshoe cable.

9.27.1 580EX II/600EX/600EX-RT autoflash

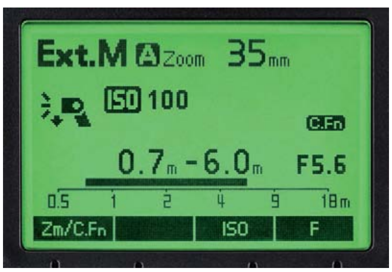


9.115

These high-end units are somewhat complex to use in autoflash mode, cryptically referred to in the manual as "external flash metering." It has two forms—automatic (Ext.A) and manual (Ext.M)—that are enabled by a custom function on the 580EX II and the MODE button on the 600EX/600EX-RT. When the Speedlite is in autoflash mode, the LCD will display either E or Ext.A for auto, or EM or Ext.M for manual, and E-TTL metering is disabled.

Automatic external flash metering works only with cameras with ESC support, as listed in appendix C. To engage it, set custom function 5 to setting 2. The camera will then feed the current ISO and aperture settings to the flash unit, which performs its autoflash calculations based on that data. However, the flash unit will not fire if it's on an older camera that cannot return ISO and aperture data to the flash unit. ☐ 9.115

To engage manual autoflash on a 580EX II, set custom function 5 to setting 3. On a 600EX/600EX-RT press the MODE button until Ext.M appears (if it doesn't, adjust custom function 5). This mode requires you to manually input both the ISO and aperture settings. To do this, press the SEL/SET button and enter the appropriate data via the control dial. Manual autoflash mode is compatible with all EOS cameras. Bracketing (FEB) and flash exposure compensation are not possible with autoflash. ☐ 9.116



9.116

ESC menus (see below) can be used to turn on autoflash in a simpler fashion. It's also possible to combine autoflash with wireless control.

9.28 Optical slave triggers

No Canon Speedlite has built-in optical slave functionality (as opposed to optical wireless E-TTL slave functionality). Only the film-era 480EG has the option: a socket into which the tiny “Slave Unit E” sensor can be plugged. This transforms the 480EG into an optical slave unit that will fire in response to another flash unit firing, but which cannot meter automatically. Some third-party flash units, such as models sold by Sigma and Metz, do support the feature. ☐ 9.117

For more details on optical slaves, see section 11.7.

9.117

9.29 Custom functions (C.Fn) on flash unit

Some EX Speedlites have custom functions much like those found on camera bodies. These “functions” (settings or options, really) allow the behavior of the flash units to be customized to your needs. For example, there are custom functions that switch from E-TTL to TTL flash metering, or that disable the AF assist light. If any custom function is set to a non-default setting then the C.Fn icon (or CF on older units) will appear on the flash unit’s LCD. Custom functions can’t be set if the unit is in any wireless mode or in Live View mode.

To alter a custom function on the 580EX II, press and hold the C.Fn button until C.Fn appears on the LCD. Use the +/— buttons or the rotating dial to select a function, and press SEL/SET (or the dial’s button) to change the function. When the function information starts to blink, select the function setting and press SEL/SET again. Press MODE to exit the custom function mode. Custom function settings are memorized by the flash unit even when it’s turned off.

On the 600EX, 600EX-RT, and MR-14 EX II, press and hold function button 1, Zm/C.Fn until the custom function screen appears. Navigate through the functions using the dial and SET/SEL. You can also alter certain personal functions as well, by pressing function button 1 (P.Fn) from within the custom function screen.

On the 430EX III/430EX III-RT, press the SUB MENU button. Select C.Fn by using the dial and pressing SEL/SET. Use the dial to navigate through the functions. Use the same method but select P.Fn to alter personal functions.

There is rough consistency between custom functions across later Speedlite models, which is why some units may have certain numbers missing in their selection of custom functions. For example, the 430EX II lacks custom functions 3 through 6, as well as 12 and 13, so that its function numbers match those found on the 580EX II. A full list of flash unit custom functions is included in appendix D.

Older Speedlites and cameras don’t have textual menus, and so you have to look up each custom function in a manual unless you memorize all the cryptic numbers. It’s not unusual for photographers to photocopy the C.Fn page of the product manual and stash it in their camera bags for this reason.

9.118

9.119

9.120 No need for this!

Speedlites with dot matrix screens can display the names of custom functions in full-text form. Cameras and flash units with external Speedlite control (see below) also have the ability to set flash custom functions through an easy-to-read, full-text menu system.

9.29.1 Personal functions

Some newer high-end Speedlites such as the 600EX/600EX-RT and MR-14EX II also have "personal functions" (P.Fn) along with custom functions. I'm not sure why they're separated from the C.Fn list, but P.Fns tend to be features that don't really affect operation of the unit, but which can be configured to match a photographer's taste or preferences. For example, you can set your 600EX-RT to have an orange backlight in master mode and a green backlight in slave mode, rather than the default setting of the other way around. Or perhaps you find it annoying to have the wireless button cycle through optical wireless mode when you only want to use radio mode—you can set the button so it simply switches radio wireless on or off. ☐ 9.121

9.121 Personal function 1 lets you change the contrast setting on this unit's LCD display.

9.29.2 Resetting default settings

Some cameras have a button marked CLEAR, or a "Clear all camera settings" menu item, which resets the camera's internal settings to factory defaults. If Speedlites with ESC (see next section) are connected and powered on, then performing a "clear" on the camera will also reset the flash unit's internal settings.

Some flash units like the 430EX III/430EX III-RT ("Set. Clear") and 600EX/600EX-RT (press function buttons 2 and 3 together) also have a clear feature that does the same thing. Custom functions are not reset.

9.122

9.30 External Speedlite control (ESC)

Post-2007 EOS cameras with DIGIC III and newer processors (appendix C) are able to adjust most features of compatible Speedlites through on-screen menus. When such a camera has an ESC-compatible Canon Speedlite in its hotshoe or attached using an Off-Camera Shoe Cord, then the option "Flash control" or "External Speedlite control" will appear in the camera's menus. ☐ 9.112

If an older Speedlite or a non-Canon flash unit is attached, an error message will appear in the ESC menu. The message can be misleading, as it only means that the flash unit is not compatible with ESC—it doesn't necessarily mean that the flash unit is incompatible generally. ☐ 9.123

9.123

Features that can be controlled from the camera's ESC menu vary from one camera/flash unit combination to another, but they typically include flash mode, first or second curtain sync, FEB (bracketing), FEC (compensation), flash metering, flash firing, manual power output, autofocus assist,

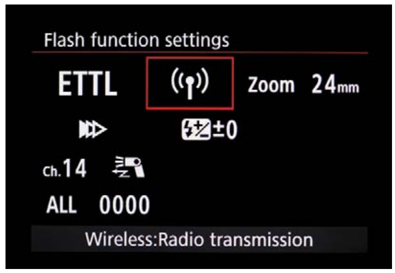
and custom functions in full-text form. Even control over such elaborate functions as configuring wireless E-TTL is possible, and in fact the wireless control menus are notably easier to use than many on-flash controls. The ESC menus also control internal flash units. Inexpensive small Speedlites like the 90EX and 270EX can *only* be configured by ESC, since they lack external controls. A Speedlite's custom functions (C.Fn) can be set via ESC, but strangely, any personal functions (P.Fn) cannot.

FEC on the flash unit's external controls will take priority if both are set. In terms of custom functions and the like, the flash unit will use whatever setting was last set. Certain camera bodies may need firmware updates to enable full control of recent Speedlite models. The pulsing AF assist light feature of the Speedlite 270EX, for example, requires an update for some camera models, and can only be enabled on cameras with flash menu control.

There are two basic types of ESC. Cameras released from 2007 through 2011 have a text-only menu interface and are not radio-aware (with such cameras you have to operate radio wireless through the flash unit's built-in controls). Post-2012 radio-aware cameras have an upgraded form of ESC that features some graphical menus and, of course, can enabled and control radio wireless.

The feature is sometimes clunkily described in printed manuals as "Speedlite Control with the Camera's Menu System" or "Setting Flash Functions with Camera Operations," but I refer to it as "External Speedlite Control" or ESC since it appears under that name in EOS camera menus. Appendix C lists the cameras and flash units that support the function.

9.124 The 270EX is completely devoid of external buttons, knobs and dials. Just a power switch and a charge light adorn the back.



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9.31 Memory function

The 600EX/600EX-RT, 430EX III/430EX III-RT, and ST-E3-RT have the ability to store wireless settings for retrieval later on. This can be very handy if you're doing a pre-planned shoot, though only one memory configuration can be stored at any given time.

To access the memory function on the 600EX/600EX-RT in master mode, press function button 4 to bring up MENU 4. Use function button 3 for MENU 3 on a slave unit. On a 430EX III/430EX III-RT, press the SUB MENU button, then use the dial to select the MEMORY option.

Once in this menu, press function button 3 (MEMORY) on a 600EX/600EX-RT/ST-E3-RT. Then press function button 1 to SAVE the current settings, or function button 2 to LOAD any previously stored settings. On a 430EX III/430EX III-RT, use the dial to select the SAVE option.

9.126

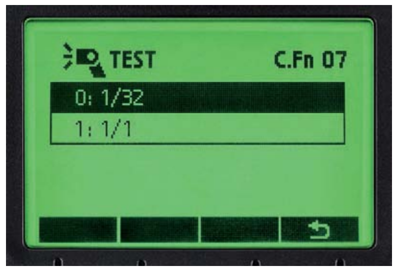
9.32 Test flash (manual firing)

Pressing the illuminated "PILOT" light on the back of most Speedlites will fire a test burst, whether on-camera or not. Most flash units will fire at full power, but some have a custom function that allows for a 1/32 low-power burst instead. ☐ 9.127 and 9.128

Speedlites with Quick Flash/Rapid Fire have a two-color LED behind a transparent button. This button will glow green if the unit is charged up enough to fire a partial flash, and red if it's fully charged and able to perform a full-power flash.

The pilot button is also used for waking a sleeping flash unit that's gone into Save Energy mode (section 9.27). If the flash unit is a master wireless E-TTL device, it will command a slave flash unit to fire wirelessly. Of course, the test flash button can also be used for open flash techniques.

9.127



9.128

9.33 Rear control dial

High-end Speedlites from the 580EX on have a rear-panel control dial that can be used for quick and easy control of various settings, such as flash exposure compensation. The dial is activated by pressing the center SEL/SET button. Rotating the dial changes the current settings, and pressing the center button again confirms them. The 430EX III/430EX III-RT, in fact, is completely reliant on the dial for navigating menus.

These units also have a custom function, which allows FEC to be changed by simply rotating the dial rather than by pressing the dial's button first and then rotating it. ☐ 9.129

9.129

9.34 Weatherproofing

All recent Canon professional series cameras and lenses have flexible rubber gaskets around every opening and seam. You can't go diving with the gear—they're *weatherproof* and not *waterproof*—but they do repel moisture, dust, and dirt.

The 580EX II, 600EX, and 600EX-RT also have weatherproofing around all seams and connections. However, while many pro-level EOS bodies are weatherproofed, only certain later cameras have a gasket around the hot-shoe that can mate with the gasket on the flash unit's foot. ☐ 9.130

Generally, Speedlite feet and gaskets work best with cameras of the same era or newer. However, sometimes rubber gaskets don't work very well with pre-weatherproofed cameras. If a flash unit is behaving erratically, you could try removing the gasket.

With the release of the 580EX II, Canon also updated a number of flash accessories to have similar levels of weatherproofing. The CP-E4 battery pack (section 12.12.1) and the Off-Camera Shoe Cord OC-E3 both have rubber gaskets. The SB-E2 bracket (section 12.10.07) also uses the OC-E3.

9.130

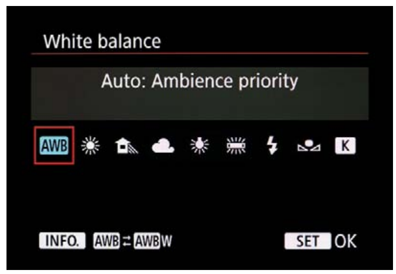
9.35 Flash color

The output of a flash tube is almost always slightly bluish-white in color. This is why xenon gas was chosen by flash pioneer Harold Edgerton all those years ago: the light it produces is pretty close to the color of daylight. But there are a couple of issues here.

9.35.1 Automatic white balance compensation

First, the color temperature of a flash tube can vary subtly depending on its precise voltage and pulse duration. The more recent Speedlite EX flash units can monitor battery power levels and communicate with compatible digital cameras to compensate automatically for slight variations in color temperature. For this to work, the camera has to have its white balance set to automatic (AWB) or flash modes. There is no indication of this function on an external control panel—it occurs silently and automatically. ☐ 9.131

Cameras that support the feature have the phrase "Color temperature information transmission: Provided" or something similar noted in the White Balance section of their Specifications list in the manual. (See appendix C.)



9.131

9.35.2 Filter holders

Second, there are often times when you'll want to change the color of the flash completely. The only way to do this is to put a light-absorbing filter over the flash head to alter its color, as described and shown in section 7.19.3. The 600EX/600EX-RT ships with an optional holder for color-correction filters, and has special sensors to detect whether such a filter is in place. The flash unit recognizes two types of Canon filters: color temperature orange (CTO) +1/3 stop ("low") and CTO +1 stop "high." If the camera is radio-aware, then its white balance can be set to AWB (automatic white balance) and it will adjust automatically to the presence of the filters. If not, you'll have to use manual white balance.

Note that the automatic system can only detect Canon-supplied filters, or third party filters designed specifically for the 600EX/600EX-RT. If you're using a generic filter with the Canon holder, you'll need to set personal function 05–1 to turn off automatic filter detection. The 430EX III/430EX III-RT comes with an optional clip-on amber filter.

9.132 The 600EX/600EX-RT filter sensor.

9.133 The clip-on amber filter that ships with the 430EX III/430EX III-RT.

9.36 Live View, silent shooting, and flash

A camera's Live View mode, which allows for a live display of video from the sensor chip straight to the back panel LCD (or to a TV set), can cause complications for flash on certain models. E-TTL flash metering occurs when the shutter is closed and the mirror is down because the evaluative light sensor is located inside the prism assembly. But in Live View mode, the shutter is open and the mirror is up so that the camera's image sensor can be exposed continuously to light.

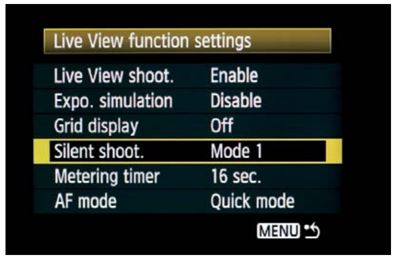
Consequently, a flash photo taken in Live View requires an extra step. The mirror must flip down so the E-TTL preflash can fire, and then the mirror must flip up again for the Live View image to be captured while the subject-illuminating flash is fired. A camera taking a flash photo in Live View mode will make two clicking noises, even though only one picture is taken.

An additional problem is the Silent Shooting mode. In this mode, the camera turns on the image sensor to begin an exposure, a technique known as electronic first shutter, rather than opening the mechanical shutter. Because of timing issues with the CMOS chip architecture, it then closes the mechanical shutter to end the exposure. However, E-TTL flash requires a preflash to be fired with the mirror up, eliminating the usefulness of an electronic first curtain shutter. For this reason, EOS cameras with Silent Shooting will disable the feature when a Canon Speedlite or compatible flash unit is attached and turned on. ☐ 9.134

9.134

Cameras with Live View Silent Shooting (see appendix C) don't send sync commands to the PC port or the hotshoe when a non-Speedlite flash unit is used. Therefore, when using a third-party flash unit, such as studio flash, disable Silent Shooting or else the flash won't fire.

Finally, the 500D can't fire non-Speedlite external flash units when Live View is engaged. ☐ 9.135



9.135

9.37 Cycle time and high voltage ports

Flash units work by storing up energy in a capacitor or capacitors, then releasing the power through the flash tube in a burst of light. It takes time to recharge the capacitor, a period known as the cycle (or recycling) time, and sometimes accompanied by the rising high-pitched whine of the charger. The cycle time can range from a fraction of a second to several seconds, depending on the design of the flash unit and also, in the case of battery flash units, on the power level of the last flash burst.

Most battery-powered flash units will only completely discharge (empty) the capacitors when firing a full power burst. When firing a lesser burst, the circuitry cuts off the power to the flash tube after the desired output has been achieved, thus retaining energy in the capacitor. Accordingly the cycle time will be shorter with a partial flash discharge than with a full power burst. (This is not the case with most studio flash units, which adjust flash output by power and not pulse duration.)

Many professionals covering rapid-fire events such as weddings and sports need the shortest cycle time possible. They can't risk a lost shot while the flash ponderously recharges. Unfortunately, most Speedlites are driven by four modest AA cells—not exactly powerhouse technology. One solution is to use external battery packs to dramatically reduce the cycle time (section 12.12).

Canon equips high-end flash units with high-voltage sockets. These allow external packs to deliver additional high current directly to the flash circuitry, keeping cycle times low. However, the flash unit still needs its AA batteries to work, since the AAs also power the flash unit's computer. The high-voltage port simply drives the flash tube output.

The 580EX, 580EX II, 600EX and 600EX-RT also have a custom function that controls whether the flash tube is fed power only from the battery pack, or from both the battery pack and the built-in AAs. The former is recommended, since recycle time is about the same either way, but the flash unit is more useful if its internal batteries aren't drained.

9.136

9.38 Remote shutter release

Why would a book on flash photography talk about triggering a camera's shutter by remote control? Well, it turns out that some Canon Speedlites have this feature built in. What's the point of this, especially since small remote control shutter releases are available very cheaply? Convenience, mostly. It's just handy to be able to fire the shutter remotely using a device you already have with you. It also means, in the case of RT Speedlites, you can trigger the camera in sync with the flash if you want.

9.137 A Canon RC-1 pocket remote.

9.138 The remote button on a Speedlite 320EX.

9.38.1 Infrared control: 270EX II and 320EX

Most of the better consumer to midrange Canon EOS cameras since the 1990s can have their shutters fired by little handheld infrared controllers. When set to remote mode, the camera will wait for a rapid series of invisible infrared pulses from a Canon RC-1, RC-5, or RC-6 remote, and take a photo accordingly. This is a great feature for taking group shots where you want to be in the frame, or for triggering the camera without running the risk of bumping it and blurring the exposure, such as for macro photography or long exposure shots. ☐ 9.137

The Speedlites 270EX II and 320EX are compatible with this system. So, if your camera has an IR receiver, then these flash units can trigger it by pressing the remote release button on the side of the flash unit. The feature is independent of optical wireless flash. ☐ 9.138

9.38.2 "Linked shooting" radio control: 600EX-RT, 430EX III-RT

RT Speedlites can also fire some cameras remotely when used in pairs (one transmitter flash unit and one receiver). The connection between the flash unit and camera depends on whether the camera is radio-aware or not.

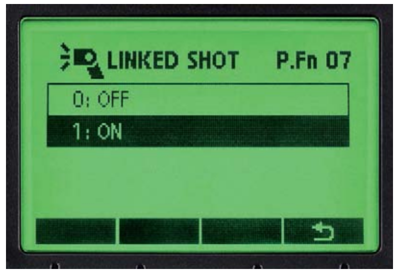
Radio-aware cameras can be commanded to fire if the RT Speedlite is sitting in the hotshoe (or connected via an off-camera shoe cord).

Older radio-compatible cameras cannot work in this mode, and so can't be used with the 430EX III-RT in linked shooting mode. However, the 600EX-RT has a special socket for compatibility with older cameras. Higher-end EOS cameras have a Canon-proprietary remote control socket, known as an N3 connector for Canon cable switches. The SR-N3 adapter cable can go from the 600EX-RT to a camera's N3 socket. (If your camera isn't radio-aware, and hasn't got an N3 socket, then remote control is not possible without a third-party adapter cable.)

If you've got a master/slave combination set up in this fashion, press function button 2 on a 600EX-RT slave unit to switch to MENU2. Then press function button 1 (REL) to take a picture on a 600EX-RT master flash unit's camera.

To use linked shooting on a 430EX III-RT, press the wireless (⇄) button of the group of four buttons. Turn the dial until LINKED SHOT is selected, and press SEL/SET to check the box. You can then set if the flash unit should be a master or slave unit by choosing the mode that appears beneath LINKED SHOT. Set transmission channel and wireless radio ID as normal. □ 9.139

To take a photo using a slave 430EX III-RT, press the SEL/SET button and select the REL option to engage the shutter release.



9.139

9.38.3 Linked shooting with multiple cameras

The RT Speedlite remote shutter release feature can also trigger up to 16 cameras, including cameras attached to both master and slave flash units. The ST-E3-RT, though billed as a device for master control of remote slave units, can also act as a radio slave in this context.

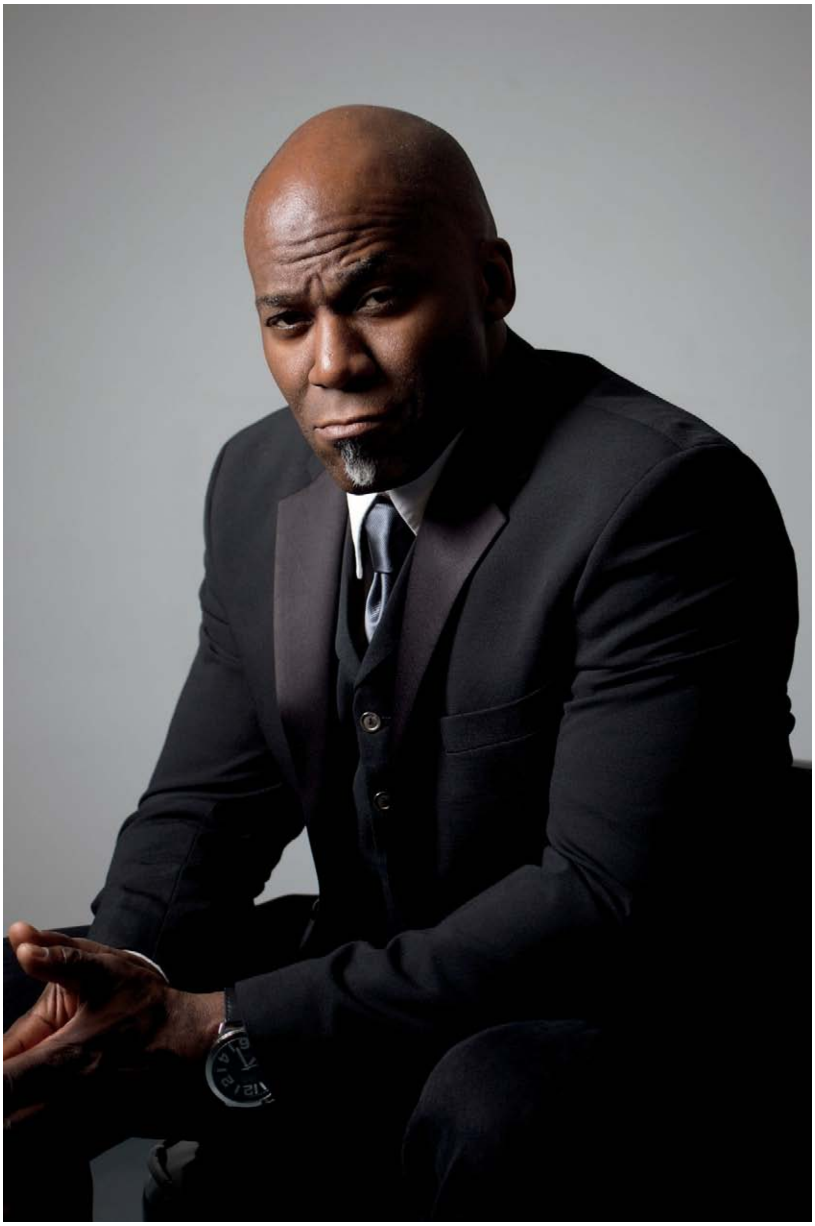
The ability to fire multiple cameras is particularly useful for news gathering. If you're a sports photographer with remote cameras stashed away in the rafters of the basketball court, behind the glass backboard, and overlooking the crowd, you can capture the moment from various angles simultaneously. Naturally, it's best to prefocus each lens and lock it in manual focus mode, to avoid problems with autofocus "hunting." Unfortunately, there is a slight lag time for radio control, so this feature isn't precise enough to shoot 3D "timeslice" or "bullet time" effects.

10 Manual Flash Metering

London Eye. Snowfall over the London Eye Ferris wheel, London Southbank, England. A 580EX II flash unit was handheld over the camera and triggered manually at half power in order to illuminate and freeze the falling snow. Without flash the fast-moving and dimly lit snowflakes would not have recorded in the final picture. EOS 5D, 0.8 sec at *f*/5.6, ISO 100, 22mm.

This is an example of totally manual open flash to highlight foreground objects.

The automatic flash metering technologies described in the previous chapters are quick and easy to use. They're ideal for casual snapshots or for rapidly changing situations such as those encountered by photojournalists. But, while computers are great at performing rapid calculations controlled by complex programs, they're pretty lousy at making artistic judgment calls. Automatic flash metering systems are designed to create flat, even results, which aren't necessarily what you want.



10.1 This photo was taken in a simple studio setting. Exposure on the camera was in manual mode, set to 1/50 second at *f*/5.6. A single Bowens Gemini monolight in a medium-sized softbox, positioned camera left, was used. For more details on these items consult chapter 13: Studio Flash.

Automatic systems are designed to measure light that is *reflected* off flash-illuminated objects. If light from a flash unit is directly visible—perhaps because a unit is pointing towards the camera or light is reflecting off a shiny surface—then automatic metering will be thrown off and the scene will probably be quite underexposed. This is a real problem with on-camera flash when there's a mirror in the frame. Auto flash can also struggle when multiple flash units are fired together.

For these reasons, ultimate control over lighting is achieved by using manual flash. "Manual" is quite literally that: the output level of each flash unit is set directly by you using buttons or dials, without a single automated metering system in sight. The metering for the scene is done using a handheld flash meter or just empirical testing. The flash units are carefully positioned to light the scene, usually augmented with various light modifying devices such as reflectors, umbrellas, or softboxes.

In a sense, manual flash involves stepping back in time to the era when sync (timing of the flash with the shutter opening) was the only real control that the camera had over the flash unit. With automatic flash, the brightness of the flash unit is determined by the camera. With manual flash, it's all up to you.

Manual flash sounds daunting, but many developments over the past few years have contributed to the technique's resurgence in popularity.

10.1 Manual flash metering

As mentioned earlier, manual flash metering is tricky to master because the effects of a brief pulse of light can't be visualized by the naked eye. The ambient light meters built into all EOS cameras can't be used for manual flash metering since they're not designed to do so.

There are essentially two ways of determining correct flash exposure without using automated flash: trial and error, and flash meters.

10.2 Trial and error

This is simply the process of taking a photo, examining the results, then adjusting the flash output by hand. Repeat until good results are obtained.

In the days of film this was pretty impractical, since regular film cost a lot of money and took time to develop and print. Professionals working in a studio would often shoot Polaroid instant photos (frequently using interchangeable Polaroid backs on their cameras) to test out lighting situations, but this was more for testing lighting quality, not for metering.

In today's digital world, trial and error is actually a straightforward and workable option, even though it initially sounds a little crude as a technique.

10.2.1 Manual flash in a digital age

The arrival of digital has changed everything. Digital cameras boast preview screens, histograms, and EXIF shooting data, all of which simplify manual flash dramatically. Now you can tell within a second whether a given manual flash setup has worked or not. If it hasn't, it's easy to fix and reshoot. The feedback loop has been tightened, transforming the technique.

10.2 A photo taken using two Bowens Gemini R studio flash units, powered by a Travelpak battery. No flash metering was used; output levels were set by hand based on experience and judicious examination of the camera's preview screen.

Reviewing a camera's LCD after a shot (jokingly known as "chimping") is easy to deride. But it has opened the doors to countless photographers who wouldn't have learned manual flash techniques so easily before. Indeed, this sort of light metering technique may offend photographers trained in traditional methods, since it can be a bit of an intuitive hit or miss. On the other hand, it's also straightforward and effective, even if the photographer may not completely understand the specifics of how flash works. With time, an experienced photographer will learn the most likely flash levels required to illuminate a given scene, and will only need a test shot or two to hone the settings. □ 10.3

10.3

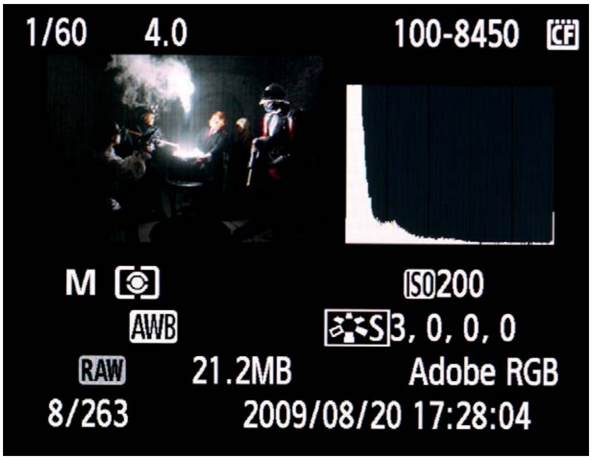
The Internet has also been a driving force in the changing destiny of manual flash metering. In early 2006, photojournalist David Hobby started a modest photographic blog, Strobist.com, which he used as a teaching tool for getting beginners to take their flash units off their cameras. Within a couple of years, the site had become the hugely popular central hub for learning about and evangelizing off-camera flash photography, typically using affordable battery-powered flash units. Now "strobism" is often used to refer to the field in general.

10.2.2 Digital histograms

Histograms are an invaluable tool for determining correct exposure for either ambient or flash-lit photographs. All digital EOS cameras can display these small charts next to an image on the camera's preview screen. The chart can indicate brightness (black and white) or RGB (color) information, and can show the frequency of occurrence for each pixel level in the image.

Camera histograms are simple bar charts with each bar showing the frequency of a given range of brightnesses—dark to the left and bright to

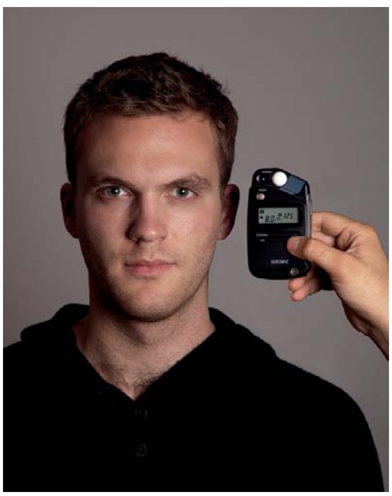
the right. A histogram skewed to the left is a dark image, and a histogram skewed to the right is a bright image. Analysis of a histogram is a sophisticated way to determine how well an image has been exposed. An image with a lot of bars on the left side might require more illumination, for example. Or an image with a number of bars lined up on the right side might be heavily overexposed and blown out.



10.4 A very dark image. The histogram clearly shows that the bulk of the pixels making up the photo are over to the left, or dark, end.

10.5 A lighter image. The histogram indicates that a fair number of pixels are essentially pure white, with some midtones (skin color) and dark areas (hair).

10.3 Flash meters



10.6

A flash meter is the traditional tool used to measure flash output with control and precision: a handheld device that can measure the brief pulse of light from a flash unit. They're not cheap, but they're an essential tool for studio professionals who need accurate, predictable, and repeatable results. Flash meters may be overkill for the average hobbyist, but it's useful to know how they work.

A typical flash meter is shown in use in figure 10.6. The meter is held close to the model's face while a test flash is fired. The white dome on the top of the unit picks up the light from the flash, and ignores ambient light levels. This is known as *incident* flash metering and is different from the *reflective* metering used by EOS cameras and other SLRs.

Reflective meters, like those in a camera's viewfinder assembly, measure light bouncing back from a subject. Since reflected light has to travel back to the camera from the subject, distance comes into play (see the inverse square law, section 7.14). A highly reflective object far away may meter the same as a darker object closer up. Also, since reflective meters are designed to average everything out to a midtone gray, they can have problems metering very light or very dark subjects.

Modern, sophisticated multiple-zone evaluative light meters are designed to avoid some of these problems but can't eliminate them entirely, since even the most advanced computer program can't know a photographer's creative or artistic intentions. A moodily lit portrait of a person in a dark room, for example, might be overexposed by an automated camera, which tries to bring up the exposure of the dark areas at the cost of correct exposure of the face.

10.3.1 Incident light metering

Incident light meters record the actual light falling on the subject. This ensures that they correctly measure the amount of light required to illuminate the subject and aren't fooled by distance or the reflectivity of the subject. The drawback is that they have to be positioned close to the subject to record the light levels accurately, as shown in figure 10.6. This is fine in a studio situation, but it could be unworkable for a photograph of a vast landscape.

One of the key advantages of incident meters is that they can be used to measure the amount of light falling on different parts of a scene. Take, for instance, the example of a person in front of a white background. The background should be pure white, but if it were to be excessively lit, then light would spill over onto other areas. By using a light meter, it's possible to measure (in *f*-stops) the difference in illumination between the background and subject. Then—assuming the background and subject are lit by different lamps or flash units—the output of those devices can be adjusted precisely. Studio photographers and cinematographers (though the latter measure continuous light levels and not flash) often walk the set to check light levels before shooting, using this technique.

Of course, many meters are multipurpose in nature. The Sekonic flash meter shown in figure 10.7 can also measure ambient lighting, either incident or reflective spot, as well as flash. It can even display flash levels as a percentage value compared to the ambient light levels. Ambient metering is essential for metering exposures with older film cameras that lack internal light meters, such as many view cameras. Finally, this Sekonic model has a built-in PocketWizard transmitter (section 11.10.1), which means that it's easy to fire compatible radio-equipped flash units right next to the subject.

10.7

10.4 Choosing a manual flash unit

Quite simply, any flash unit with manual output controls will work. Some units have sliders, some have knobs, and some have buttons. A manual flash can be anything that permits the amount of light produced by the device to be adjusted at will. It can be an old battery-powered hotshoe flash unit from the 1970s, a brand new manual-capable unit designed for a different camera system, or an AC powered studio unit (section 13.1). All that's needed is manual output control and some way to connect a sync

cable or other trigger so that the unit fires when the camera takes a photo.

10.8 This studio unit, a Bowens Gemini monolight, has two dials on the side that are used to set the light output.

Wholly automatic flash units generally aren't useful for this technique. Many can only fire at full power when triggered by hand, which affords little control over manual flash.

10.9 This shot was lit by two flash units, both controlled by sync-only optical triggers. One was a Speedlite 580EX II, located camera left. The other was the Bowens Gemini monolight shown above, located on the floor behind the mannequins.

Manual flash begins with connecting a flash unit to the camera or to a triggering device. In the case of a hotshoe flash unit, this can be done by sliding the device into the camera's hotshoe. In the case of off-camera flash or studio equipment, it can involve attaching an electric cord, a light sensor, or a wireless controller. But before anything is physically connected to the camera, the matter of trigger voltages must be addressed.

10.5 Trigger voltages

Electronic flash units work by pumping high voltage electricity through their flash tubes. These powerful electrical discharges are fired by a triggering voltage, and many older flash units connect the trigger circuitry directly to their controlling switches. That means when a camera's flash contacts close, there may easily be anywhere from 50 to 200 volts flowing through them. This isn't a problem restricted to AC powered studio flash, since even battery-powered flash units have high-voltage internal circuits. Battery units use special step-up circuitry to transform the low voltage from the batteries into the high voltage needed to power the flash tube.

Old mechanical cameras could handle such high voltages with aplomb, but many EOS cameras employ delicate flash sync contacts. Some EOS shutter switches are only rated to six volts and can be destroyed by high voltages. The damage isn't usually instantaneous but cumulative with repeated use, as arcing and pitting slowly destroy internal components. So it's vitally important to check both the trigger voltage of a flash unit and the maximum trigger voltage of a camera before plugging in any non-Canon flash unit in.

10.10 This old Vivitar flash unit built in the 1980s has a trigger voltage of just over 8 volts. Whether this is safe or not on a camera rated for 6 volts is something of a judgment call. It's probably fine, as a 2-volt difference isn't that significant, but anything much higher should probably not be connected directly.

10.5.1 Measuring the trigger voltage

Measuring a flash foot is quite simple. First, fully charge up the unit by turning it on and waiting for its flash ready light to glow. Then take a voltage-measuring device, such as a simple multimeter or multitester, and set it to measure DC volts. Touch the black (negative) probe of the multimeter to the side connector of the flash unit's foot and the red probe to the foot's center contact. The meter will display the trigger voltage. ☐ 10.10

If the trigger voltage exceeds the camera's limits, then a voltage-limiting device can be used. These accessories sit between the camera and the high-voltage flash, keeping things at a safe level. ☐ 10.11

Trigger voltage mismatches aren't a universal problem, particularly with most 1-series cameras and recent digital EOS bodies. Instead of fragile electric switches, these cameras use semiconductor switches that can withstand up to 250 volts. Consult appendix C for a table of models that have this capability. Conversely, most flash units on the market today are designed with low trigger voltage circuits because of this issue; it's mainly older models that can be a problem.

But to be honest, it's simpler just to use an optical or radio trigger, which bypasses the whole trigger voltage problem altogether and eliminates the hassle of using a cable. See chapter 11 on off-camera flash.

10.11 A Wein SafeSync. While somewhat crude-looking, this device can save a camera's shutter from flash-derived destruction. It fits into a camera's hotshoe and also allows PC cables (section 11.4) to be plugged into cameras that lack PC sockets.

10.6 Incompatible shoes

10.12 This Nikon shoe is not compatible with EOS cameras.

Generally speaking, hotshoe connectors designed for other camera systems are completely incompatible with EOS cameras. This is because they use different pin configurations. ☐ 10.12

Some devices have all-metal cold shoes for accessories, or hotshoes with incompatible pin configurations. These could be a problem if they inadvertently short out any of the four small data contacts on EOS cameras or flash units.

Of particular concern are cheap flash units with large, crude central hotshoe contacts. If such a contact were to touch one of the four EOS data contacts, damage could occur if the device has a high trigger voltage.

10.7 Autoflash metering

10.13 A classic Vivitar 285

It's worth mentioning the earliest form of automatic flash metering: "autoflash," exemplified by the venerable Vivitar 283/285 hotshoe battery units introduced in the early 1970s. These flash units are self-metering, and the only control the camera has over the flash unit is a sync signal.

Autoflash units contain small light sensors on the front that monitor the amount of light reflecting back from the subject when the flash fires. It's kind of like filling a car's empty fuel tank and stopping when the numbers on the pump hit a predetermined point.

Once a reasonable exposure is determined by these sensors, an electronic component known as a thyristor is used to shut off power from the flash tube, immediately "quenching" the light. There is a relationship between the duration of the flash pulse and the distance from the subject, with longer pulses generally needed to illuminate subjects farther away. Autoflashes are sometimes referred to generically as "thyristor" flash units, though this is inaccurate since many flash units are thyristor-based but are not autoflashes.

Autoflash works surprisingly well despite its simplicity. In fact, many experienced wedding photographers and photojournalists still rely on autoflash units in today's digital age, since the units can give fairly predictable results with experience. However, an autoflash is easily fooled by dark areas or highly reflective surfaces, can't distinguish between light reflecting back from objects outside the frame of the photo, and can't be used as a fill flash very easily. It's also generally designed to meter for the typical area covered by a normal lens, so it will meter inaccurately if used with a long telephoto or a very wide lens.

10.14

Autoflash requires more knowledge on the part of the photographer and really only works in single-light setups. Most autoflash units require the ISO/film speed to be set along with the lens aperture. Based on these two pieces of data, an autoflash will attempt to meter correctly using the built-in sensor on the front of the unit. ☐ 10.14

Autoflash has never been a key part of the EOS technology lineup, though the discontinued Speedlites 480EG and 200M used it. A modern variant lives on in the 580EX II and 600EX/600EX-RT. Canon refers to the technology these days as "flash external metering"; abbreviated as Ext.A and Ext.M. Ext.A works only with post-2007 digital cameras, as it automatically detects the camera's ISO and aperture settings and uses that for the autoflash calculations. Ext.M requires you to plug the ISO and aperture settings into the flash unit yourself.

Some third-party manufacturers, notably Metz, manufacture autoflash units that can be used with EOS cameras.

11 Off-Camera Flash

Goulas Ceramic Studio. Firostefani, Santorini, Greece. Courtesy ceramic artist Andreas Alefragís. On-camera 580EX as E-TTL master, set to 1/64 power in manual mode for slight foreground fill. 580EX II with full CTO gel on shelf below the seahorse, illuminating the back wall as E-TTL slave. EOS 5D Mark II, 1/15 sec at *f*/8, ISO 100, 55mm.

Probably the only time we see the world illuminated by a beam of light emanating from our foreheads is when we're wearing head-mounted lamps, such as the ones on caving helmets. Headlamp lighting isn't, it has to be said, a particularly natural way to see the world. Camera-mounted flash units, whether built-in or clipped on, inevitably produce flat and uninspiring photographs. It's even worse when the flash unit is the main or only light source.

So the first step in improving the quality of flash photography is to get that flash off the camera. There are seven basic ways to control a flash unit that's located remotely.

11.1 The Seven Basic Methods for Off-camera Flash Control

The first way is to fire the flash manually, with no automatic control. But if you want to synchronize the flash with the camera then three methods are available: a physical cord, wireless light commands (optical), and wireless radio. Each of these methods can be used to send either sync-only commands or full metering instructions.

11.2 Off-Camera Method 1—Open flash

The simplest way to trigger an off-camera flash unit harkens back to the introductory chapter and the techniques used by Victorian photographers: just fire a flash unit by hand when the shutter is open. This is "open flash," and has no automation for either synchronization or metering. It basically means that the shutter has to remain open long enough for the flash to be set off.

For the example, in figure 11.1, a camera was attached to a sturdy tripod and the lens prefocused. The camera was set to ISO 100 with an aperture of *f*/5.6 and an exposure time of 30 seconds. The shot was triggered using a wired remote control to avoid bumping the camera. Exposure settings were based purely on previous experience. This is an area where light meters aren't much help—long exposure photography is all about trial and error, as well as checking preview screens and EXIF data.

Since the photo was taken facing a pre-dawn sky under very low light, the trees essentially ended up as black silhouettes. My eye could make out details in the trunks, but the camera lacked the dynamic range to do so. Two handheld bursts from a 580EX II filtered with a half CTO filter brought out the missing detail.

11.1 Dawn over bristlecone pines. Schulman Grove, Inyo National Forest, White Mountains, California, USA. Dendrochronology (tree ring counting) has established that some gnarled and ancient trees in this grove have been growing continuously for over 4,000 years, with the oldest specimen over 4,700 years old. The sprightly young trees in this photo are a fraction of that age.

11.3 Off-Camera Methods 2 and 3—Wired cords

The simplest way to control a flash unit and synchronize it with the camera is to use a physical cable between camera and flash unit. This isn't always the most practical method, as wires can be pretty inconvenient sometimes. They tangle, restrict the range, and generally get in the way. But they fire flash units pretty reliably and are usually inexpensive.

11.4 Off-Camera Method 2—Wired sync-only: PC cords

If you just want to fire a flash and don't need automatic metering or any other advanced functions, traditional PC cords may fit the bill. These are simple electric cords that can carry a synchronized trigger signal but can't carry metering data or any other information. In other words, they can't be used to adjust or specify the flash unit's power output.

The coaxial (cylindrical) design of 3.5 mm PC plugs dates back to at least the early 1950s. "PC" stands for "Prontor-Compur." The term is derived from two brands of German-made leaf shutters used in older cameras, which is why it's sometimes called a "German" socket. It doesn't stand for "personal computer": a PC cable can't plug into a computer.

KEY POINT
Sync-only means a camera can send a simple "fire now!" command to a flash unit but can't specify any other information, such as output levels.

11.2 This Super Ricohflex camera from the late 1950s has a simple coldshoe bracket. That small metal cylinder is a PC terminal for hooking up a flash.

Canon has never really promoted the PC cable solution, since the cords can't support flash metering. Only high-end Speedlites have PC connectors. However, most midrange and high-end EOS cameras have PC sockets. These are intended primarily for studio flash systems, though they can of course be used with battery flash units.

11.3 A PC socket on a camera body, or the answer to the question "Why does my camera have a socket marked with a flash icon that doesn't connect to anything I own, including my flash unit?"

11.4 LumoPro "Universal Translator." This adapter has a foot, a hotshoe, a PC socket, and a 3.5 mm minijack, allowing it to connect to all kinds of things.

PC cables can be used on EOS cameras with no PC ports by using a hotshoe adapter, such as one shown above. These adapters take the sync signal from a PC cable and connect directly to the central point, the sync contact, on the camera's hotshoe. ☐ 11.3

Two other issues are PC connector polarity and trigger circuit voltage. Most flash units have a positive tip and negative sleeve, but a handful of devices have the polarity reversed. Certain EOS models are incompatible with positive sleeves. And, as noted in section 10.5, some flash units have dangerously high flash trigger voltages that can damage cameras.

11.5 This studio portrait was taken using a pair of monolights in softboxes. One was synchronized to the camera using a PC cable. The other was triggered optically using a slave cell.

11.4.1 PC connector problems and other sync plugs

PC connectors have a famously unreliable mechanical design, leading people to joke that the acronym should really be "Poor Connections." The tiny friction-fit sleeve has to conduct electricity, which it does fairly well, but it also has to hold the plug in place physically, which it does quite badly. PC plugs are notorious for falling out at the slightest provocation. The problem is exacerbated when people attempt to tighten the plug by squeezing it with pliers (or even their teeth), which just worsens the poor contact by making the sleeve go out of round. ◻ 11.5

There are three approaches to the PC problem. First are plug conditioners, which are simple metal tools used to tighten and round the metal sleeve. They can mitigate damage but don't address the underlying weakness of the plug design.

Second, there are threaded "screwlock" PC plugs that fit most PC sockets, but which also have sturdy threaded collars that hold the plugs securely in place when used with compatible screwlock PC sockets. Canon and Nikon both use the screwlock PC connector on their digital SLRs and some flash units. Oddly enough, while many devices use threaded PC sockets, the actual screwlock PC cables are difficult to find and are never included with any kits. The one shown here is from FlashZebra. ◻ 11.6

Finally, other sync-only plug types can be used to avoid the weakness of the PC connector.

11.6

11.7 Screwlock PC plug

11.8 3.5 mm (1/8″) minijack

11.9 1/4″ audio jack. Similar to the minijack, but the large size seen on full-sized headphones. These are frequently seen on U.S. and U.K.-built studio flash units.

11.10 Elinchrom Amphenol. Large sturdy connector used on some Swiss-built Elinchrom studio equipment. Reliable, but too big to be used on cameras or portable flash units.

A 3.5 mm (1/8″) minijack is a mono version of the standard plugs used for the headphone jacks of mobile phones and the like. These are seen on various devices, from PocketWizard remotes (section 11.10.1) to Elinchrom D-Lite flash units (section 13.1.5). They are cheap, readily available from electronics stores, and reliable. One minor drawback is that they can short briefly when unplugged, causing misfires. ◻ 11.7, 11.8, 11.9

"Household" bladed plugs, with two flat blades, are the same as those used for household power in North America and Japan. They're a very bad choice for safety reasons. It wouldn't be a good thing for a child to plug a bladed plug into a power outlet if the other end were connected to a camera. Fortunately, these plugs are no longer common on flash units. ◻ 11.10

11.11 Household bladed plug. Terrible design seen on some older U.S.-made studio flash units.

11.4.2 Speedlites and PC cables

Manual control over the flash output is needed for a PC-triggered flash unit to be useful. For this reason older Canon Speedlites are actually less useful for all-manual flash than units from other makers, since they usually lack PC sockets and sometimes have no manual output controls. Speedlites may also suffer from the SCR lockup problem described in section 11.7.6.

Though few of Canon's flash units have PC sockets, simple and inexpensive adapter blocks that attach to the foot of a flash unit are readily available from other vendors. □ 11.12

11.12 An adapter that goes from a non-screwlock PC plug to a 3.5 mm minijack.

11.5 Off-Camera Method 3—Wired with automatic metering: Canon flash cords

There are two extension cord systems from Canon. The first supports all automatic flash metering options on nearly all cameras, whereas the second only supports TTL for film cameras. Neither uses PC connectors. □ 11.13

11.13 This foot adapter from FlashZebra uses a 1/8″ or 3.5 mm minijack instead of a less reliable PC connector.

11.14

11.5.1 The Off-Camera Shoe Cord

A shoe cord is a coiled extension cable that links a flash unit's foot to a camera's hotshoe, up to a stretched-out distance of about two feet. The cord preserves all Canon flash functions, including TTL and E-TTL. In fact, the camera actually won't know that the flash unit isn't sitting in the hotshoe. There have been three versions of the cord.

The first OCSC dates to the 1980s, and it just has a rotating pressure ring to keep it on the hotshoe. The flash shoe has a plastic screw socket for a regular 1/4–20 tripod bolt.

OCSC 2 adds a spring-loaded, locking hotshoe pin. The flash shoe end also has grooved sides compatible with a cold shoe, making it useful for portable umbrella setups.

OC-E3, the Off-Camera Shoe Cord 3, is basically a heavier OCSC 2 with a metal foot, a lever lock instead of a pressure ring, and a metal bushing for the tripod socket. It also has rubber gaskets that mate with those found on weatherproofed EOS bodies and Speedlite flash units.

11.15 Clockwise from top left: an OCSC 2, an original OCSC, generic clone copy of the OC-E3 (note thinner cord), and a Canon OC-E3.

While an essential tool for any EOS user, the cords are fairly short, since they're basically intended for attaching a Speedlite flash to a flash bracket. Canon presumes that longer off-camera distances will be handled wirelessly. It's possible to connect two together for a little more distance, but Canon doesn't recommend this since the electrical impedance changes and reliability drops. Third-party manufacturers do make compatible cords with longer wires.

11.5.2 Multiple TTL flash cords for film cameras

Before wireless E-TTL, Canon sold a corded system for TTL flash on film cameras. The system uses a camera-mounted TTL Hot Shoe Adapter 3, powered by a lithium battery. 60 cm and three-meter connecting cords connect to remote Speedlites via Off-Camera Shoe Adapters (OA-2) and a TTL distributor. Each device uses a Canon-proprietary plug similar in shape to a mini-DIN connector.

Developed for the T90 in the 1980s, these cords are obsolete today. They're expensive, lack advanced features, and work with TTL film cameras only. ☐ 11.16

11.16

11.17 Photographers often joke that asking someone to hold a flash unit is using a “voice activated light stand.” Here the model playing the paparazzo is doing just that. The camera visible in the frame is simply a prop, but the Speedlite 480EG flash unit is actually providing the bulk of the light for the scene. It’s triggered optically using the small green sensor on the back of the unit. The master flash is a 580EX II on the picture-taking camera, dialed down to 1/64 manual so it contributes relatively little light.

11.6 Off-Camera Methods 4 and 5—Wireless optical control

Wires can be inconvenient, awkward, and inflexible. A studio full of cables is a trip hazard, and it doesn’t take much to send a top-heavy monolight or stand-mounted flash unit crashing to the floor. Wireless control, either optical or radio, is a great solution.

Optical devices use simple pulses of light to encode commands. Just as Boy Scouts can turn flashlights on and off to signal each other at night, optical transmitters send information to compatible receivers by brief blinks of light. The light can be visible to the human eye, or can be infrared energy that behaves just like light (except for the fact that people can’t see it) at certain wavelengths.

Unfortunately, optical devices have one significant limitation: beams of light are blocked by opaque objects and have limited distance ranges.

11.7 Off-Camera Method 4—Wireless optical, sync-only: optical slaves

The simplest method to sync a flash unit wirelessly, if you don't need automatic metering, is to use an "optical slave" light sensor. These sensors do nothing when incoming light is at ordinary ambient levels, but they respond to the bright pulse of light from a flash unit by triggering any attached flash unit.

Because optical slaves react so rapidly, the triggering is effectively instantaneous. A group of flash units triggered optically can be thought of as firing in unison, though of course there's actually a fraction of a second delay between the triggering (master) flash unit firing and the responding (slave) flash units firing. Any number of flash units equipped with optical slave sensors can be set about a scene for complex lighting scenarios. There are no limits other than budget and physical space. ◻ 11.17

Some flash units have optical slave capabilities built in. Most studio flash units, for example, have basic optical triggers. A few third party battery-powered units, such as the Sigma EF-610 DG Super, also contain optical slave sensors. No Canon E-series Speedlite has one, though an optional add-on slave sensor was sold for the Speedlite 480EG (section 9.28).

Slave sensors for battery-powered flash units are usually small plug-in devices that attach to a flash unit's foot, a PC socket, or a similar connector. They typically don't need batteries.

Optical slaves are a great solution for low-cost wireless triggering but do have a number of limitations.

11.18 Two low-cost optical slaves: a Hama Synchromat (left) and a Sonia slave from FlashZebra (right). The generic Hama device, available from online auctions, does not work properly with Speedlites—see section 11.7.6 on SCR lockup. The green Sonia unit is designed specifically for Speedlite compatibility. It's the tiny device encased in clear plastic resin, shown here plugged into a hotshoe adapter. The adapter in turn fastens to the flash unit's foot, though it can be plugged directly into any flash unit with a compatible minijack socket.

11.7.1 Line of sight and range

Optical sensors obviously have to "see" the pulse of light from the triggering flash unit. Small or medium-sized rooms, especially if they have light-painted surfaces such as walls or ceilings, are usually okay since light bounces around everywhere. But outdoors, or in large indoor venues like ballrooms, optical slaves may not respond without direct line of sight. Range depends on the sensitivity of the slave and the power output of the triggering flash unit.

11.7.2 Misfires from other units

Standard optical slaves are difficult to use outside the controlled environment of the studio, since they cheerfully respond to any nearby flash unit that happens to fire. This can be a real nuisance for wedding photographers who find their carefully configured flash units suddenly going off every time Uncle Bob takes a photo with his flash-equipped point-and-shoot. There's no way for a simple optical slave to discriminate between one triggering flash and another.

Short of banning the ubiquitous Uncle Bob, public situations like this call for wired solutions or wireless triggers with some form of digital encoding. Canon wireless E-TTL and most radio triggers are two options.

11.7.3 Optical slave E-TTL misfires

KEY POINT
Simple optical slaves are not compatible with E-TTL flash.

E-TTL flash metering sends out a low-powered preflash for measuring light levels. Unfortunately, this preflash is usually bright enough to trigger "dumb" optical slaves. So if you use an E-TTL flash unit to trigger a dumb optical slave then either the picture will be completely dark, because the subject-illuminating flash has already ended by the time the shutter opens, or the picture will be dimly lit because only the tail end of the slaved flash unit has been recorded. The time between the preflash and the main flash firing is too brief for most flash units to recharge and trigger a second time.

An inconvenient workaround is to press the * (autoexposure lock/AEL) or FEL (flash exposure lock, if the camera has a separate FE lock button) button to fire the E-TTL preflash first; wait a moment, then take the photo. Since the preflash must be fired before each photo, this isn't a very practical solution. Some optical slave units intended for use with digital point-and-shoot cameras are designed to ignore preflashes, but these are uncommon. Some sensors on more advanced studio units can also be programmed to ignore a certain number of prefires before the subject-illuminating flash.

11.7.4 Disabling E-TTL on Speedlites

A better approach than using FE lock is to disable E-TTL on the Speedlite altogether. Most advanced Speedlites have a custom function or mode selector that puts the device into TTL mode only. However, not all digital cameras will fire a flash unit when it's in TTL mode, so this may not work. Also, a flash firing in TTL mode will work as a trigger, but it might end up contributing more light to the scene than is really desired. Angling the flash head away from the scene, or putting an infrared filter (see below) over the head can help. Dialing in the maximum amount of flash exposure compensation can also work.

The best solution is to put the unit into manual flash mode and specify a low power output, such as 1/64 or 1/128. This setting should trigger the optical slave without contributing much actual light to the scene. Unfortunately, not all flash units have a manual mode. See appendix C for a list of Speedlites that can operate in manual mode.

Another option is to use a thin piece of plastic to cover the four small pins on the camera's hotshoe. This forces the flash unit to revert to all-manual behavior, though, in this case, most will fire at full power only.

A final complication involves built-in flash. All EOS digital bodies use E-TTL for their internal flash units. Only post-2007 EOS bodies, with optional manual control over popup flash, are useful for triggering dumb optical slaves.

11.7.5 Light and infrared

As noted above, sometimes you don't want light from a triggering flash unit to actually light up the scene. Usually dialing down the output and angling the flash head away from your subject is enough, but sometimes you need a truly invisible optical slave trigger.

An infrared filter installed on the flash head is the answer. Such filters are opaque black and block visible light but let infrared (IR) through. Flash tubes generate both light and infrared, and optical slaves generally detect infrared, so this trick works quite well—though at the cost of some range. In fact, commercially available optical slave triggers are nothing more than low-powered flash units with their flash tubes masked by infrared-passing filters.

Sheets of IR-passing material can be purchased from better camera stores. Failing that, sandwiching together red, green, and blue gel filters is a reasonable approximation. In a pinch, a piece of unexposed but developed slide (E6 transparency) film will work.

Infrared filters can be used on flash units that only fire at full power. However, this is rarely useful since flash units at full power take a few seconds to recharge, and the heat can cause a filter to melt or fade.

11.19 Prolinca (left) and a Kenro/Interfit (right) flash transmitters, both of which are basically small flash units with plastic infrared filters. They work quite well as flash triggers, though their cycle time of a second or two is slower than radio. The Kenro unit has an energy-saving sleep feature that can't be disabled, making it annoying in studio settings.

11.7.6 Compatibility problems (SCR lockup)

Canon Speedlite flash units are incompatible with many dumb optical slave triggers, such as the Hama unit shown in figure 11.18. Such optical slaves can fire a Canon Speedlite only once, and then the flash unit will unhelpfully lock up. It will remain inert until it's turned off and back on again. The problem doesn't harm the Speedlite, but obviously limits its usefulness with optical slaves. When shopping for an optical slave device, be sure to buy one designed for Canon Speedlites, such as the green version of the Sonia slave shown.

Technical note: This is sometimes referred to as "SCR lockup" since it's caused by a silicon-controlled rectifier (SCR) in the optical slave that's not resetting. This appears to happen because the Speedlite's trigger circuit does not drop to zero volts.

11.8 Off-Camera Method 5—Wireless optical with automatic metering: Canon optical wireless E-TTL

Canon E-TTL's primary innovation was improved metering over TTL, but wireless capabilities were a key feature as well.

Optical wireless E-TTL is pretty well identical to regular E-TTL from the point of view of the user, the main difference being that the control signals are sent through the air from camera to flash unit by rapid pulses of light. No wires are required, just line of sight between the devices (or reflective surfaces to bounce the light).

11.20 A small boutique in Bruges, Belgium, illustrating how available light alone can be a problem. The ceiling light fixture and window are both overexposed to allow for adequate exposure of the interior. In addition, the room in which the camera is located, visible to the right side, is not as brightly lit as the main room. EOS 5D, 1/6 sec at f/4, ISO 100, 24 mm.

11.21 This photo is lit by an on-camera 580EX master flash unit that has its head angled to the ceiling. This illuminates the belts on the wall to the right and controls the slave unit. The 420EX slave is positioned in the other room, camera left. In addition to improving the interior lighting, the use of flash permits a lower overall exposure setting, bringing the outside to a more reasonable level. Note one drawback: the belts to the right and the bags on the top right shelf have some unfortunate flash shadows. EOS 5D, 1/8 sec at f/8, ISO 100, –1 FEC, 24 mm.

The simplest technical comparison is a TV remote control. In the case of TV remotes, small infrared (IR) LEDs send rapid-fire, digitally encoded pulses of invisible energy bouncing around the room. A receiver built into the TV set receives the signals, decodes them, and responds accordingly, perhaps by changing channels or muting the volume. In other words, the remote can be used to send a variety of different instructions to the TV set, not just "turn on now." The fact that the remote transmits invisible IR energy and not radio waves is easily demonstrated by simply putting a finger over the LED or panel on the remote's front to interrupt the signal.

Flash units are conceptually similar, but instead of infrared LEDs, ordinary xenon flash tubes are used to produce rapid-fire bursts of digitally en-

coded light. These precisely timed pulses can be interpreted by fast-reacting computers and decoded, sort of like Morse code. The preflashes instruct the remote flash units when to fire and at what brightness. In other words, both sync *and* metering are fully supported in a transparent way.

Camera manufacturers are the primary makers of these light triggers for flash units. Canon, Nikon, Sony, Olympus, and Pentax all sell incompatible, but technologically similar, light-based flash controllers in their SLR lineups. Canon's system, known as optical wireless E-TTL, is built into most Speedlites sold today.

11.8.1 How optical wireless E-TTL works

Canon's optical wireless system requires at least two flash units. A *master* flash unit is attached to the camera, and any number of *slave* flash units are set up to illuminate the scene as desired. Post-2007 EOS models can also use their built-in flash units to command remote slaves.

11.22 An EOS 5D equipped with a 580EX II serving as a master Speedlite. The master sends control signals to the two slave units in the front. Note how the flash heads on the slaves are rotated 180° so that the wireless sensors on the fronts of the units face the master.

As a side note, it has long been a convention in engineering circles to refer to a device that issues commands as a "master" and a device that receives such commands as a "slave." This unidirectional design is in contrast to a "peer-to-peer" model in which either device can send or receive commands. Obviously the words "master" and "slave" have regrettable historical meanings. But, since Canon and other manufacturers use these terms, they're used in this book in place of other popular synonyms (e.g., commander/remote, transmitter/receiver, etc.).

Many EX series units can serve as a master, which has to be electrically linked to the camera. This can be done either by putting the flash unit into the camera's hotshoe or by using an Off-Camera Shoe Cord that transmits the necessary computer data (section 11.5.1). EX macro units can also serve as masters, though only under special circumstances as described in "Macro

ratios" (section 11.8.6). The master unit can be told to contribute light to the scene, or it can be set simply as a controller unit. There's also the Speedlite Transmitter ST-E2, a special master-only unit that lacks a scene-illuminating flash tube and only works as a flash controller.

Most EX units sold today can serve as a slave. A number of flash units built by third-party manufacturers are also compatible with Canon's wireless system. The remote units must be set to slave mode, in which their front-mounted optical sensors dutifully sit and wait for pulsed signals of light from the master unit. The commands are so rapid that, to the human eye, they look like a single brief flash, but in fact complex messages and instructions are sent out. Virtually every standard E-TTL function is supported wirelessly through these control commands. One notable exception is second curtain sync.

There's no limit, other than physical space and your budget, to the number of optical slaves that can be used. No two-way communication occurs between master and slave units. Each slave simply responds to commands, and the master only knows what slave units exist in terms of whatever light they produce during the prefire stage.

To be really useful, Canon's optical wireless system needs an E-TTL camera. When used with older type B film cameras, Canon wireless flash works sync-only but can't support any form of automatic flash metering, including TTL or A-TTL.

11.8.2 Line of sight

Optical wireless E-TTL is ideal for quick, portable, and flexible flash setups in smaller spaces. However, optical signals have two significant restrictions. First, light signals are thwarted by walls, tables, people, and other opaque barriers. Second, the range is limited; flash units can't be triggered remotely from great distances, such as from the other side of a stadium or even across a large ballroom.

11.23 The dark panel above the Canon logo on this 430EX II conceals the wireless flash sensor.

Each slave must be positioned so that the wireless sensor on its front can see the master's signals, either directly or reflected. When shooting indoors with many light-reflecting surfaces (walls, ceilings, etc.) a slave can often detect a master's control signals even if the two units aren't set up to point at one another. But outdoors or in a non-reflective indoor setting (vast ballroom, black-painted nightclub, coal mine, etc.), the slave's sensor must be able to see the front of the master.

The sensor is behind a dark plastic cover on the front of the unit's body. Slave-capable flash units have rotating heads, so you might need to turn the flash head so that it points in a different direction from the body. The master unit can also be put on an off-camera shoe cord rather than directly onto the camera body if necessary. Each slave must see the master directly, and there's no capacity for relaying with intermediate devices.

11.24 This photo of Kikunoya guest house in Kanazawa, Japan, is lit by available light only. The garden is lit by sunlight, and the room interior is lit by fairly low tungsten light.

11.25 The same scene as in figure 11.24, shot with an ST-E2 as an on-camera master and a 420EX as a slave. The 420EX was on the other side of the right-hand screen in the hallway area, but enough of the ST-E2's control signal passed through the shoji rice paper screen to trigger it correctly.

There's a common misconception that optical wireless E-TTL masters transmit invisible infrared signals, like the aforementioned handheld remotes used to control TV sets. This actually depends on the master unit used. All EX series master units, such as the 580EX or the MT-24EX, pulse their subject-illuminating flash tubes to send commands, so they produce both white light and IR. However, the ST-E2 master-only unit (section 9.7.7) transmits discreet invisible infrared only.

Command transmission distance depends partly on the angle at which the master is transmitting relative to the slave, whether the signals are direct or are bouncing off surfaces, and which master unit is used. EX units, with their powerful flash tubes, have a greater transmission distance than the tiny ST-E2.

11.8.3 Optical wireless channels and groups

There are four different data "channels" for flash control, and each slave unit can also be put into one of three "groups," sometimes referred to as "slave IDs." The numbered channels (1–4) allow up to four cameras to use wireless E-TTL in the same physical location without conflicting with each other. They're named by analogy to radio or TV channels but don't actually use different transmission frequencies—each slave detects all incoming commands, but only responds to those on the channel to which it's set.

You usually don't want all your slave units to fire at precisely the same power or output level. Thus the three groups or slave IDs (A through C) permit independent flash output ratios to be specified within a given channel when used by most cameras. In other words, all slave flash units set to the same channel will always fire simultaneously. But the different groups allow finer control over the units by letting you specify relative brightness of the flash units in the groups. For more information, see the next section on ratios.

You can check whether or not the slave units are within transmission distance by pressing the test ("pilot") button on the master flash unit. The camera will instruct all the slave units to emit a flash of light in sequence. First the A group units will flash, then B, and then C. If the camera has modeling flash capabilities (section 9.24), then a quick preview of the final scene can be viewed.

11.8.4 Wireless E-TTL ratios

As noted earlier, there'd be no point in being able to control multiple groups of flash units if they all fired at the same power level anyway. Consequently, most E-TTL capable cameras can specify the output levels of up to three separate groups of remotes—or five when using radio wireless E-TTL (section 11.11.1).

The primary means of control is the ratio of light produced by groups A and B. Confusingly, this A:B ratio can be set from 8:1 to 1:1 to 1:8 in half-step or third-step increments, for a total of 13 steps or a 6-stop range (e.g., 1/8 of the light is –3, stops and 8× the light is +3 stops). More specifically: 1:1 means both A and B groups fire at the same power; 8:1 means that the group A units put out much more light; and 1:8 means that the group B units put out much more light.

11.26

Ratio	8:1	4:1	2:1	1:1	1:2	1:4	1:8
Stops	3	2	1	0	1	2	3

If a Speedlite EX unit is the wireless master, then its internal flash tube defaults to group A. To control the ratio of slave unit output to master unit output, be sure to put the slave units into group B. Note that wireless flash ratios are unrelated to fill flash ratios between flash and ambient lighting.

EX master units can also specify flash compensation for a third and completely independent group: group C. Group C units don't fire unless the ratio setting has been set to "A:B C." Unlike A:B ratios, compensation of group C is adjusted from –3 to +3 stops relative to the A:B ratio, in third-step increments. Group C can't be adjusted relative to group A or B only, since it's assumed that group C is used primarily for background lighting. Unfortunately the ST-E2 can't control group C.

The earliest type A (E-TTL capable) film cameras don't support wireless E-TTL ratio control, and all flash units on the same channel will fire at the same power. When using a 500/600 series unit as a slave, there is a partial workaround: flash exposure compensation can be specified manually using the flash unit's controls.

Regrettably, unlike radio E-TTL, optical E-TTL doesn't let you set exposure values for each group or turn specific groups on and off. Automatic control is restricted to ratios, an A:B ratio and a compensation for C separately. This system assumes a main, fill, and background flash lighting model, making

it a somewhat restrictive system. The new radio system offers much more flexibility over each group (section 11.11.1).

11.8.5 Manual wireless E-TTL control

Although the ratio system is limiting, optical wireless E-TTL does permit manual control. To access it, press and hold the MODE button on the master unit until M appears. It's now possible to control slave flash units manually by dialing in the desired power output, such as 1/4 or 1/16. This will instruct all slave units to fire at whatever power output they produce for that fractional setting. This technique doesn't work very well with flash meters, since they tend to be confused by the optical wireless commands, but it works well when using digital preview screens to check the results.

You can also control the three groups separately using manual control. Put the master unit into M mode, then select the RATIO option as described above and choose A:B:C. The flash output power for each of the three groups can now be specified manually, though of course it's technically not a ratio at all. This system lets you set arbitrary power output levels for each of the three groups (e.g., fire group A at full power, group B at 1/2 power, and group C at 1/8 power).

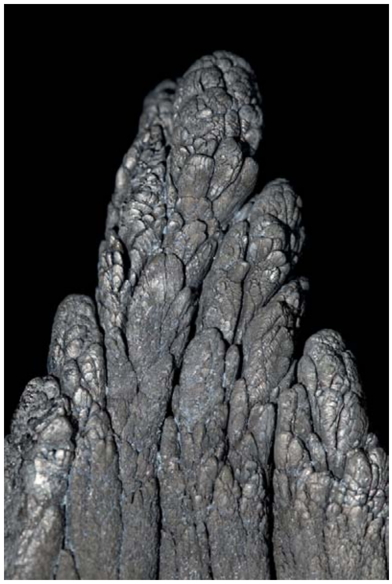
11.8.6 Macro ratios

The MR-14EX, MT-24EX, and MR-14EX II macro units can serve as master units in wireless E-TTL setups, though not in the way you might expect. One of the two flash tubes on the macro head is assigned to group A and the other to group B (the tubes are labeled). The controls on the flash unit controls the output ratio between the two tubes when used with a ratio-capable camera. You can also make just one tube fire, if you want. Figures 11.28 through 11.33 demonstrate different setups using the MR-14EX (the Mark II version is identical in this context) and the MT-24EX.

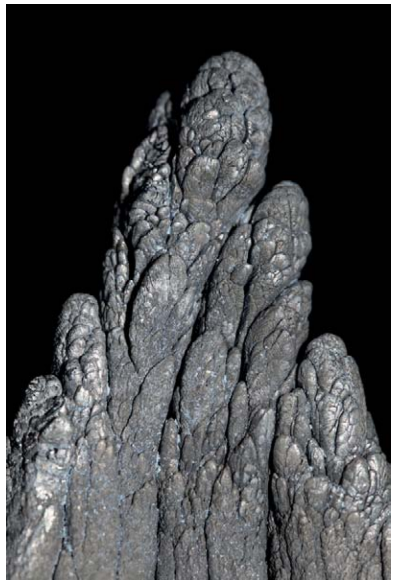
11.27 The Speedlite MT-24EX has two separate flash heads, which can be positioned independently or clipped to the end of a macro lens, for flexible closeup lighting control.

Magnesium refining can produce strange-looking crystal nodules as seen here. This lightweight metal is used to build many modern EOS cameras.

11.28 A Speedlite MR-14EX set to a 1:1 ratio. This means both tubes fire at the same level, for flat and even lighting.



11.29 The MR-14EX set to an 8:1 ratio. Left-hand tube A is 3 stops brighter than right-hand tube B. (4:1 would be 2 stops brighter, and 2:1 would be 1 stop brighter.)



11.30 The MR-14EX set to a 1:8 ratio. This is the reverse of the previous example, with tube B brighter than A.

11.31 Here the MR-14EX is firing normally, but with group C enabled. A 580EX II slave is firing through a clear red plastic cup behind the nodules.

11.32 This shot was lit with an MX. Its movable flash heads were positioned far to either side, giving a more sculpted look.

11.33 An MT-24EX with group C enabled and the same 580EX and cup arrangement as 11.31.

Slave flash units are assigned to group C, so that flash exposure compensation of the slaves can be set relative to the two macro unit tubes, an ideal situation for background illumination of macro shots. A custom function on the flash unit can be set to assign slave units to groups A and B, but then their output is linked to the internal tubes.

11.8.7 Speedlite Transmitter ST-E2

The ST-E2 is a tiny hotshoe-mounted flash unit with a normal flash tube on the front. But the tube has a black plastic filter, so that visible light is blocked and only invisible infrared energy shines forth. The ST-E2 uses this IR output, carefully pulsed in coded sequences, to send wireless E-TTL commands to slave Speedlite flash units. Much smaller than any other master Speedlite device, and powered by a 2CR5 non-rechargeable lithium battery, it's more discreet in operation than a normal visible-light flash unit when controlling slave units. ☐ 11.34

11.34 Speedlight Transmitter ST-E2.

Conveniently, it has red autofocus assist LEDs on the front, and a simple pushbutton system for controlling A to B flash ratios on the back.

Unfortunately, the ST-E2 has serious drawbacks and it hasn't been updated since its introduction in 1998. The ST-E2 can't transmit its control signals as far as the 500–600 series units, and its coverage angle is narrower as well, making it useful only in medium-sized rooms. The ST-E2 supports groups A and B with A:B ratio control and, mysteriously, it can't control group C. Other missing features include flash exposure bracketing (FEB), flash exposure compensation (FEC), and control over manual or stroboscopic slave units. 500–600 series units are larger and more expensive, but are also much more capable E-TTL master units.

11.8.8 Speedlite Transmitter 90EX

Optical wireless E-TTL was considered an advanced feature when it was introduced, but Canon has gradually been migrating it down the product lineup, especially now that radio wireless E-TTL is the new high-end. Canon sells a tiny master-capable Speedlite, the 90EX, which is too weak to be a very good on-camera flash unit, but which serves as an optical wireless master. When used with a digital camera with menu control, it even provides full ratio control and manual flash output. In a sense the 90EX can be seen as an affordable replacement for the ST-E2, albeit one that lacks red autofocus-assist lights.

The 90EX, and small slave-capable units like the 270EX II, mean you can have a full wireless camera system for cameras that lack master control via popup flash—even with small bodies like the EOS M3 mirrorless camera shown here. ☐ 11.35

11.35 An EOS M3 mirrorless camera with a 90EX master. Two Speedlite 270EX II units serve as wireless slaves.

11.8.9 Popup flash master/integrated Speedlite transmitter

Since 2009, Canon has brought to its lineup the use of the popup flash to command slave flash units (section 9.18). By going to the camera's external Speedlite menu (ESC, section 9.30) you can enable fairly advanced flash features with the popup, including wireless master and manual control.

11.8.10 Third-party support for optical wireless

A number of companies make equipment that's compatible with Canon's optical wireless E-TTL.

Quantum QNexus

11.36

Quantum makes add-on QNexus modules that can interpret optical signals intended for Canon wireless E-TTL units, and that can translate them for the company's Qflash series of battery flash units. All E-TTL functionality, with the exception of high-speed sync flash, is supported transparently. From the camera's point of view, a QNexus-connected flash unit is just another Speedlite, albeit one that can pump out a lot of light. The usual groups and channels can be specified. ☐ 11.36

Qflash units are high-output flash units powered by battery packs. They bridge the gap between Canon Speedlite-type units powered by AA cells and the big studio flash units powered by battery packs the size of car batteries. This makes them ideal for wedding photographers and other professionals who need lots of light in a reasonably portable fashion. Although Qflash units lack zooming flash heads, they have glass-encased tubes to which a wide variety of light-modifying devices, such as reflectors and softboxes, can be attached.

Sigma

11.37 The Sigma EM 140 DG macro flash in wireless mode.

Sigma produces flash units that have optical wireless functions compatible with Canon's. They support the same four channels and groups as Canon, though Sigma calls the groups 1, 2, and 3 rather than A, B, and C. Ratios and other features are also fully supported.

The EF-610 DG Super can operate with Canon wireless E-TTL as both a master and a slave unit. The EM 140 DG macro flash can operate as a wireless E-TTL master. The EF-610 DG ST doesn't support wireless E-TTL.

The EF-610 DG Super is an affordable alternative to Canon units. However, wireless operation is somewhat difficult due to the DG Super's confusing user interface, and it occasionally yields inconsistent metering.

Metz

Some Metz flash units are compatible with optical wireless E-TTL, though the company also has its own wireless system that isn't compatible with Canon's. The units that support optical wireless E-TTL are generally "System Flash" units.

11.8.11 Drawbacks of optical wireless E-TTL

Wireless E-TTL is a useful basic system but is not without its drawbacks. By far, the biggest problem is line of sight and range. Outdoors, in dark-painted rooms, in huge rooms such as theaters or hangars, or in situations where there's powerful backlight from the sun, wireless E-TTL simply doesn't work very well, especially when compared to radio systems.

The ratio system for the three wireless flash groups is also not very useful. First, it's confusing because groups A and B are controlled as ratios to each other, whereas group C is controlled with exposure compensation over the combined A+B groups. Second, there's no way to simply specify the output of each group in EV or other units, and there's no way to turn specific groups on or off. These issues were all addressed when radio wireless E-TTL was developed.

11.9 Off-Camera Methods 6 and 7—Wireless, radio frequency (RF)

The most reliable way to transmit flash-triggering information wirelessly is by radio frequency (RF). There are a number of reasons why most professionals rely on wireless flash control that employs radio commands.

11.9.1 No line of sight requirement

The primary advantage is that radio signals can pass unhindered through many visually opaque barriers, and so are immune to the line of sight and distance limitations imposed by optical systems. That doesn't make them invulnerable; signals can be blocked by metal objects, or at certain frequencies, by water-filled objects such as plants or people. Dense materials such as stone walls or stucco walls with embedded metal mesh can present a barrier. Other nearby devices transmitting on the same frequencies can also interrupt a signal.

But in most cases, radios can transmit signals to flash units on the other side of walls, tucked around corners, hidden behind backdrops, and so on.

11.38 Dysert O'Dea Castle, County Clare, Ireland. This is an example of a situation where radio control works well. The room was lit by a single 580EX II, with ambient exposure lowered so that the view out the windows wouldn't be entirely blown out. Wireless E-TTL with a 580EX master couldn't trigger the slave flash unit, since it was positioned around the corner in another room, so a radio trigger was used.

11.9.2 Enhanced range

RF controllers can usually work over greater distances than optical controllers, though the range obviously depends on the product and general conditions. Advanced professional RF units such as non-TTL PocketWizards can work up to 1,500 feet in open air, though cheap products might have a range of only around 30 feet. Professional RF transmitters hold great benefits for sports photographers who need to trigger large flash units at the other side of a hockey arena, or wedding photographers who want to trigger flash units in a large ballroom for a couple's first dance.

Note one unintended consequence of using radio to control E-TTL devices: with optical wireless E-TTL, it's usually not possible to control a flash unit that's so far away that the camera's evaluative metering can't see the unit's preflash. But with radio signaling it becomes entirely possible. This isn't an issue when controlling remote flash units sync-only: if they're within radio range, the flash units will fire at whatever output level is specified.

Note also that it's wise to interpret the manufacturer's published range somewhat conservatively. Like fuel economy ratings for cars, transmitter range numbers are often somewhat optimistic in nature.

11.9.3 Digital coding

Most RF systems use some form of digital coding in their transmissions. This serves two functions. First, digital coding can reduce the risk of misfires caused by random radio noise. Very simple low-cost transmitters may transmit uncoded triggering commands, or may support just four different pulse-modulated commands. Such systems can be fooled by bursts of radio static, whereas more expensive transmitters employ digital error correction to ensure that an incoming signal is genuine. This is one of the reasons

why cheap transmitters can misfire—they're more vulnerable to accidental triggering by noisy radio devices in the vicinity.

Second, most flash transmitters send coded signals (much as a garage door opener is coded for security) so that more than one transmitter of the same brand can operate in the same area. They may also transmit on different radio frequencies, again reducing the risk of misfires caused by signals from other compatible devices. □ 11.39

11.39 Tiny slide switches used to specify security coding on a transmitter.

But even professional devices have a finite number of channels or codes available, making conflicts more likely in busy areas or when using a device with great range. Sports or political photographers covering a big event, for example, may find their flash units firing inadvertently when another photographer is shooting. Well-organized professionals covering an event may actually sit down and allocate channel or code numbers to each other in advance to avoid this problem.

11.9.4 Multiple receivers

Many radio systems, though not Canon radio wireless, support any number of receivers. When such transmitters broadcast a signal, any receiver in range that is programmed or designed to respond will do so. A single transmitter can control complex studio setups with dozens of flash units. Canon's radio wireless is an exception, with a maximum of 16 devices at once.

11.9.5 Regulatory issues

The biggest drawback of radio is that the signals have a habit of wandering off wherever they want. They don't respect walls or arbitrary human barriers, and they can interfere with other devices. The radio spectrum is a finite natural resource and is highly regulated by governments.

Governments don't want imported products that can interfere with local radio products, especially when radio frequencies used by emergency services are involved. But many frequency bands are allocated to different functions across the world. Local laws can mean a device permitted in one country might not be legally imported, sold, or even used in another. □ 11.40

11.40 Regulatory approval logos for the FCC (USA), Conformité Européene (Europe), VCCI (Japan), ACMA (Australia), and Industry Canada.

This lack of regulatory coordination explains the variety of incompatible devices available in different markets, a frustrating problem for the traveling photojournalist. For example, U.S. FCC PocketWizard transceivers operate on a different frequency range than European CE models. A U.S./Canada RadioPopper PX uses the same frequency range as GSM-900 cellphones elsewhere in the world, and so is illegal to use outside North America.

The easiest solution has been to adopt the same 2.4 GHz radio band used by Wi-Fi computer networking and Bluetooth devices. Canon radio wireless E-TTL, Elinchrom Skyports, and Paul C. Buff CyberSyncs all use 2.4 GHz. The main disadvantages are that 2.4 GHz is packed with competing devices and has a range limit compared to lower frequency signals.

11.9.6 Latency

Radio triggers often advertise a very high maximum shutter speed that isn't always achievable. Sometimes this is because of the X-sync problem with all SLRs, in which case the maximum shutter speed is going to be determined by the camera. But in other cases the flash transmitter itself introduces signaling delays, something engineers call latency.

In other words, it can take a fraction of a second for the transmitter to take the signaling information and broadcast it, and then for the receiver to decode it. This delay can be long enough to lower the maximum shutter speed. It's worth testing any new product to find out what its real-life values are going to be.

11.9.7 No cross-manufacturer support

There are no universal standards for radio trigger communications, so a product made by one manufacturer probably won't work with a product made by another. The investment in a given product line isn't always transferrable.

Occasionally, companies will license another firm's technology—such as Profoto and Bowens flash units, which support PocketWizard receivers, and some companies make clone products compatible with Canon's radio signals—but this is not the norm. In fact, sometimes two radio products made by the same manufacturer won't work together.

11.9.8 Battery drain while idling

Transmitter batteries are usually small and last a long time because most transmitters only send brief bursts of commands when a photo is taken. Receivers, on the other hand, have to sit and wait for incoming commands, and therefore require larger batteries.

11.10 Off-Camera Method 6—Radio, sync-only

A whole host of companies sell radio frequency (RF) transmitters that can be used to sync off-camera flash units but that don't offer any metering capabilities.

The LPA Pocket-Wizard system is probably the best-known product line in North America, whereas in Europe the Elinchrom Skyport and Bowens Pulsar systems are popular. Other radio remotes of note include Microsync Digital, Cactus, AlienBees/Paul C. Buff CyberSync (not discussed in this book), and Yongnuo.

11.41 When using sync-only radio transmitters, there are three basic ways to adjust exposure. If time isn't an issue, just run back and forth and adjust flash output manually. If depth of field isn't an issue, adjust the aperture. If noise isn't an issue, adjust ISO when shooting digital.

11.42

11.10.1 PocketWizard

The PocketWizard system has long been the studio professional standard for radio remotes in North America. The transceivers, while expensive, have a reputation for solid reliability and long operating ranges. PocketWizards have error detection systems to avoid misfires and are rated at distances up to 1,600 feet in open air, which is enough for a vast sports arena or Olympic venue.

The classic PocketWizard sync-only devices are black plastic boxes, about the size of a deck of cards, that attach vertically to a camera's hotshoe. The company's flagship for years was the classic MultiMAX, which was a sophisticated device with an LCD panel. ◻ 11.43

The modern Plus III model is auto-switching and decides whether to transmit or receive based on what device it's plugged into. If it's on a camera's hotshoe, it will transmit a sync signal when the shutter is fired. If it's attached via a cable to a flash unit, it'll receive the radio signal and trigger the flash unit. It supports four different digital channels and can also be used to fire cameras remotely. This latter function is popular with sports photographers and photojournalists, who sometimes hide remote cameras in interesting or inaccessible locations for unusual shots. The PocketWizard Plus X is the less expensive cousin. ◻ 11.44 and 11.45

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Conveniently, other companies produce receivers compatible with PocketWizard signaling, making it a useful product ecosystem. Profoto and Bowens both make optional add-on units that transform some of their studio flash units into PocketWizard devices. This saves the trouble of external boxes, cabling, and separate batteries for the receiver. Sekonic also sells light meters with built-in PocketWizard-compatible transmitters, making it easy to walk around a set lit by remote-operated flash units and test the lighting.

The primary drawbacks of the PocketWizard sync-only devices are cost, size, and complexity. They're fairly large and have a tall vertical orientation, which blocks sight over the top of the camera. □ 11.46

There are also different versions produced for different markets. As described above, these versions transmit on different radio frequencies and are therefore incompatible.

In short, PocketWizards are a professional studio basic. They work well for any situation in which reliable radio sync, but *not* metering, is required.

11.46

11.10.2 Elinchrom EL Skyport

Swiss studio flash manufacturer Elinchrom produces a line of portable radio triggers for its flash units. They come in two forms: the EL Skyport Universal, which can perform sync-only triggering with almost any make of flash unit; and the EL Skyport RX, which can also adjust the power output of Elinchrom RX studio flash units. □ 11.47

11.47 Three EL Skyport devices: the Skyport USB Transceiver, the Skyport Transmitter, and the Skyport Universal Receiver. Not included: the advanced Skyport Plus HS transmitter, shown in section 13.6.3.

EL Skyport Universal

The Universal models are sync-only radio triggers that consist of transmitter/receiver pairs operating at 2.4 GHz, the same radio frequency used by Wi-Fi personal computer networks. They support eight different frequencies and have an official open-air range of about 400 feet. Digital error correction is supported. The transmitters attach directly to a camera's hotshoe and are powered by a small lithium button cell. They're very small, low-profile devices that don't block the view over the top of the camera.

The receivers are powered by an integrated rechargeable battery pack, like a mobile phone, for about 24 hours of use on a single charge. They also have auto power-off after a number of hours. On the one hand, the built-in battery means no batteries to throw away or lose. On the other, it means that it isn't possible just to replace the battery on a shoot if it runs out unexpectedly. Still, the receiver can continue to function while it's recharging.

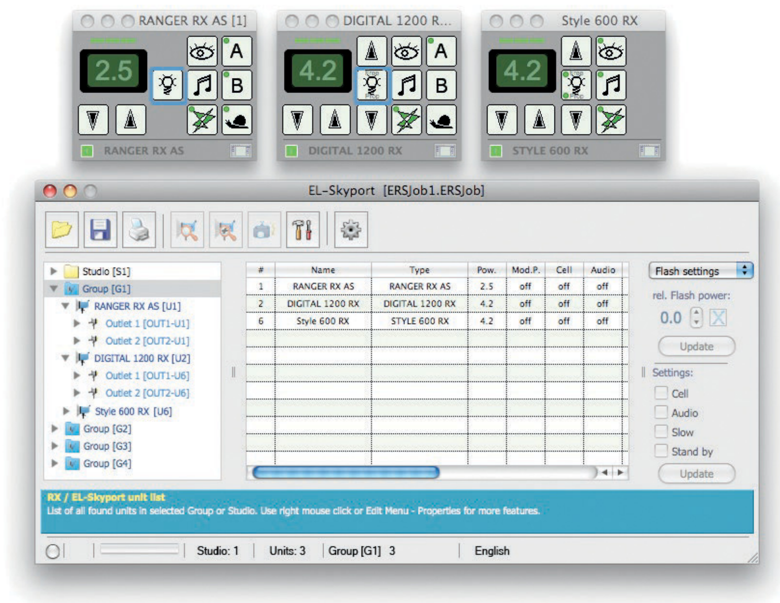
Four different groups are supported, and the transmitter can fire specific groups or all groups at once. This allows for different lighting setups to be configured and tested.

EL Skyport RX

The RX-capable Skyports add the ability to transmit power output information, though only to Elinchrom RX studio flash units. They are *not* able to handle automatic TTL-style flash metering—they simply enable the photographer to perform manual output control wirelessly, in 1/10 stop increments, without the bother of walking over to each flash unit. In this, they excel. The ability to adjust the output of multiple flash units right on-camera is great time saver in the studio. It also makes it easy to adjust the power output of a monolight in an inaccessible location, such as on a high lightstand or on a boom.

The RX system also has a version with a computer USB interface. This transmitter plugs into a Mac or Windows computer and comes with downloadable software that supports a wide range of controls. Intended for professional studio settings, the software can store commonly used settings and configurations for later retrieval. ☐ 11.48

11.48



While versatile and useful, the advanced functionality of the RX units doesn't work with any flash units other than Elinchrom RX devices. But in a studio equipped with compatible units, the ability to adjust multiple flash units directly from the camera is extremely handy.

11.10.3 Bowens Pulsar

British flash manufacturer Bowens sells hotshoe-mounted radio transceivers known as Pulsars. Each transceiver can transmit (TX) or receive (RX) sync commands at 433 MHz, depending on the position of the power switch. The devices run off two ordinary AAA cells, though a power socket is available

for continuous studio use. They're oriented horizontally and so block less of the view along the top of the camera. ☐ 11.49

11.49

The transceivers have two output jacks, one PC and one 3.5 mm minijack. The PC socket is used for flash sync, and the minijack is used for firing a flash unit or for triggering a camera's shutter release.

One useful feature of the Pulsar is its ability to handle multiple channels simultaneously. Up to four separate channels can be enabled and triggered independently, and an "all" setting lets a transmitter fire any device on any of the four channels at once. This makes it very useful for testing flash ratios and the like. The Pulsar can also transmit on any one of five separate frequencies via a switch labeled "Studio."

Another advantage is that small radio receivers can be installed in many newer Bowens studio flash units. These don't run off battery power and can't be lost, making them a very convenient radio triggering solution for Bowens users. As with the stand-alone transceivers, the built-in receivers support sync-only.

11.10.4 Microsync Digital

One of the smallest radio solutions is the Microsync Digital from U.S. camera bag maker Tamrac. This is a transmitter/receiver pair that operates on 433 MHz. The transmitter is an incredibly tiny unit that sits in a camera's hotshoe, powered by a lithium coin cell. The receiver is larger, as it accommodates two AA cells. ☐ 11.50

There are actually two models of the receiver, both geared to the North American market. One has a large 1/4" plug and the other a two-bladed "household" plug. These plugs allow the receivers to be plugged straight into many North American studio flash units. Adapter cables are required if a given flash unit doesn't have these two connectors. The cables can be a little bulky, since both 1/4" plugs and household plugs are large. Note the safety risk of the bladed version. Keep it well away from children, since the bladed receiver could be plugged straight into a power socket.

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The Microsyncs do not have any advanced features, such as the ability to transmit on multiple channels for ratios. They also cannot sync at shutter speeds higher than about 1/180 sec.

Only four channels are available, and channel selection on either device is awkward. The transmitter has a tiny hole in the side, into which a bent paperclip must be inserted to cycle through the channels. The receiver will sync itself to the transmitter if the paper clip is pushed in within 10 seconds of powering on the receiver. In a studio setting where the channel is rarely changed, this shouldn't be a problem. However, photographers who shoot in the field might find it an issue. ☐ 11.51

The Microsync's primary selling point is the extremely small transmitter. The product is basically optimized for a small studio setting where channels are infrequently changed but an unobtrusive flash sync solution is needed. It's less suited for photojournalist or field use, particularly if battery-powered flash units are used.

11.52

11.10.5 Quantum FreeXwire

U.S. flash manufacturer Quantum offers a number of radio solutions for remote triggering. The simplest is the Radio Slave 4i, which is a basic sync-only radio transmitter. A more advanced system with eight separate channels is the FreeXwire system. This can support full-metered TTL commands also transmit sync-only signals. ☐ 11.52

The basic FreeXwire Digital Transmitter can be fastened directly to the camera's hotshoe with the FW12 hotshoe adapter. The FW12 doesn't, unfortunately, support TTL signals in any way, so it doesn't take full advantage of the transmitter's capabilities. However, it is simple to use.

The FW9T transmitter, powered by a pair of AAA cells, sends radio commands at 434 MHz to a compatible Quantum receiver on a Qflash battery flash unit. ☐ 11.53

11.53

The Quantum system includes other devices as well. For example, in addition to a FreeXwire receiver, there's also a transceiver that can serve as either a transmitter or receiver, and that can actually extend the range of a signal by acting as a repeater. The Quantum system is extremely versatile, but also difficult to understand because of the vast range of products and all their permutations.

11.10.6 Cactus/Gadget Infinity V2/V2s/PT-04

These simple units from Hong Kong's Gadget Infinity were widely available from Internet auction sites, sold under different brand names, and were one of the big kickstarters in expanding the wireless flash trigger market. They were dirt cheap, and marketed to students and other beginners on tight budgets. People often jokingly called them "poverty wizards." ☐ 11.54

The set consisted of two devices: a shoe-mounted transmitter and a clip-on receiver. The transmitter was powered by a small 12-volt battery

of the type commonly used in household smoke alarms. The only other features were a single test firing button, a 3.5 mm minijack socket, and two tiny DIP switches for setting one of four codes.

The receiver was a rectangular box fastened to the shoe of a flash unit. It was powered by a non-rechargeable lithium CR2 battery—an expensive choice since receivers must be left on for extended periods, waiting for incoming transmissions. It had a crude metal bracket, tilt-adjusted by a fragile thumbscrew, for attachment to a tripod or cold shoe. The receiver also had a PC socket and a transmission confirmation LED.

These and other low-cost triggers radically transformed the remote flash market by making the devices affordable to a broad audience. Admittedly, they frequently failed to fire, were pretty flimsy and easily broken, and had a really limited range. But then they were never intended to be reliable professional products.

11.54

KEY POINT
Most inexpensive flash triggers are not compatible with each other. Even similar products from the same maker may be incompatible, and new products come and go on the market all the time. The ones listed here are just a handful of those available. Keep this lack of compatibility in mind if your goal is to build up an investment in your gear!

11.10.7 Cactus/Gadget Infinity V4

The V4 is another hobbyist product but a significant improvement from the V2 design. The units have four DIP switches for a total of 16 different codes.
☐ 11.55

Although they transmit on the same 433 MHz frequency band as their predecessors, the increased number of codes means they are not compatible with the V2 line. Anyone upgrading to the V4 will have to abandon the previous devices. Since the V2 devices aren't all interchangeable anyway, this may not be an issue.

The transmitter has a swiveling, albeit delicate, antenna and some cosmetic changes. The receiver has the biggest improvements. First, the weak rotating bracket is omitted since the device is now a simple base upon which the flash unit rests. It also operates on a pair of ordinary AAA cells, which are cheap, widely available, and made in rechargeable versions. Range is extended and officially goes up to 100 feet in open air.

11.55

11.56 One advantage of inexpensive technology: here, a group of old industrial ovens is lit by separate flash units, each controlled by a low-cost flash trigger.

The receiver has a couple of practical limitations. First, the on/off switch is blocked by the front edge of many flash units, meaning that the flash unit has to be removed to turn off the receiver. This, and the fact that the switch position is hard to see, makes it likely that the unit will be left on inadvertently, draining the batteries. Second, the receiver isn't wide enough to serve as a reliable stand, though it can be loosely attached to a normal Speedlite clip-on stand for better stability. The battery door also tends to fall off.

The V4 lacks the reliability and range of the high-end professional products, but then it doesn't really compete with them.

11.10.8 Phottix Ares

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The 2.4 GHz Phottix Ares is another inexpensive flash trigger, but sturdier and more reliable than the really cheap ones.

It comes in receiver/transmitter pairs, and can operate on one of eight channels, with the option to fire all channels. The transmitter is on a swiveling mount, and so can be horizontal or vertical. The product has a decent range, with an advertised range of 650 feet/200 meters, and the units run on two AA cells.

11.10.9 Yongnuo RF-603C II

The memorably named RF-603C II is a 2.4 GHz transceiver, so it can operate as either receiver or transmitter. Either way it's a small rounded black box that fastens to a flash unit's foot or a camera's hotshoe. The C in the product name means it's designed for Canon gear.

The units are powered by two AAA cells, and have three position power switches: off, transmit, and transmit or receive. Battery life in receive mode is 10× less than transmit-only. It has small DIP switches in the battery bay allowing for up to 16 different channels to be used, and the device can also trigger cameras remotely as well as flash units through the use of the right cable.

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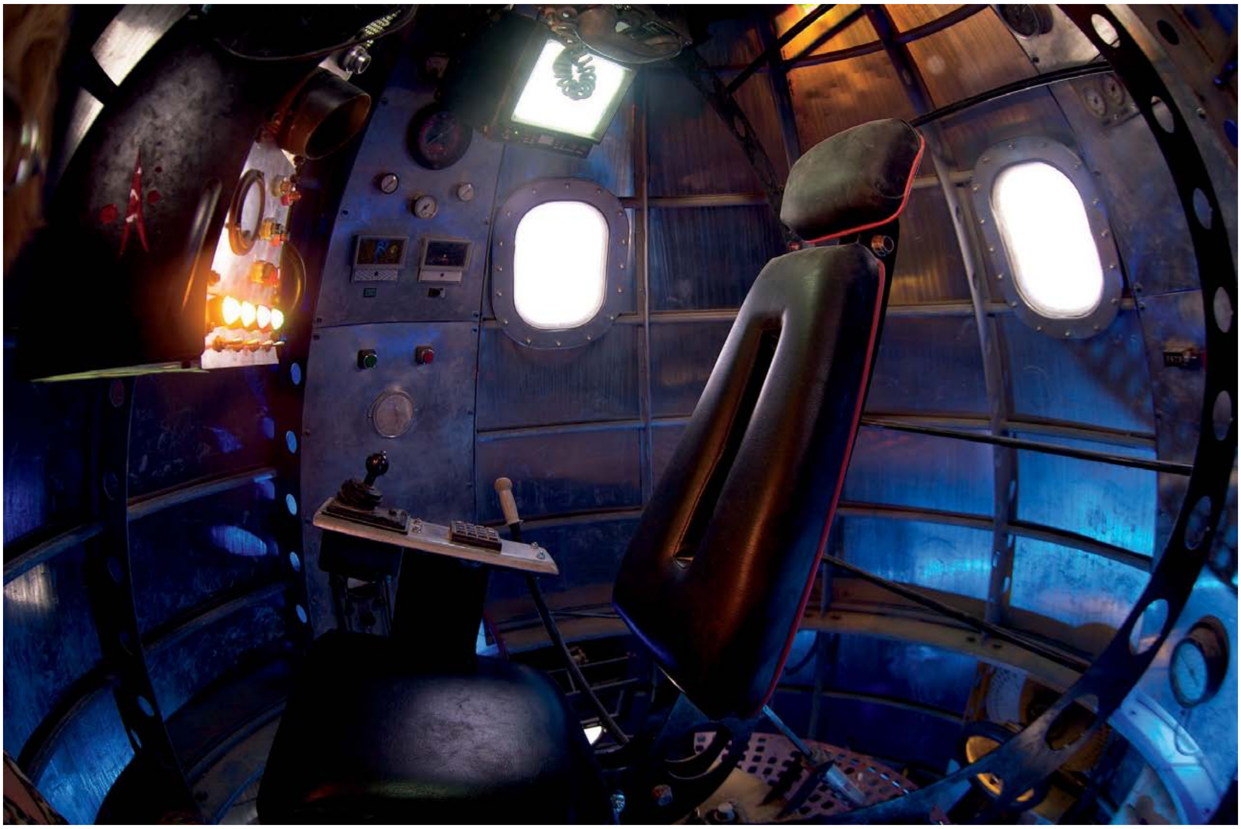


11.60 The cockpit of the Raygun Gothic Rocketship (figure 6.12). This photo is lit by a mixture of daylight coming through the portholes, tungsten lamps on the simulated displays, the glowing video monitor, and a blue-gelled 580EX Speedlite controlled by a RadioPopper wireless remote on the next floor down.

11.11 Off-Camera Method 3—Radio with automatic metering

The most technically complex off-camera flash technology is radio with automatic output control. For years this was only possible through third-party gear, but in 2012 Canon joined the party with the introduction of radio wireless E-TTL. Unfortunately, none of the systems here are interoperable, which means none of them can be used together.

11.11.1 Canon radio wireless E-TTL

It was a long time coming, but Canon's radio-frequency wireless system was worth the wait. In 2012, Canon released the Speedlite 600EX-RT, the company's flagship hotshoe-mounted flash unit that can transmit and receive radio commands using the 2.4 GHz band. Full E-TTL trigger and metering commands can be sent over the air from a master unit to as many as 15 remote flash units. Unlike optical wireless E-TTL, radio E-TTL is solid and reliable since it doesn't rely on line of sight. The system expanded in usability in 2015 with the release of the midrange 430EX III-RT.

11.61 Aside from the names, the Speedlite 600EX-RT (left) and 600EX (right) look almost identical. The absence of a working LINK light is a giveaway, though.

The latter device is particularly notable. For many years Canon only sold high-end units that could work as a master, with more affordable midrange units being slave-only. This made sense from the point of view of product marketing, but not from the point of view of a photographer. You don't need a high-powered flash unit as master— you're better off having powerful slave units. Fortunately, amid much cheering from Canon users, this all changed when the 430EX III-RT brought radio master capabilities (though not optical master, oddly) to the midrange lineup.

"RT" in a Speedlite name refers to radio technology. For licensing reasons, Canon doesn't sell RT devices in certain countries. There are thus two nearly identical versions of the 600EX and 430EX III—one with radio capabilities and one without.

11.11.2 Radio commands

Canon's radio wireless E-TTL is conceptually similar to its optical system with an on-camera master controlling off-camera slaves, but instead of using coded pulses of visible light or infrared, radio signals are transmitted. The maximum range is about 30 meters or 100 feet, depending on local interference.

While this is a great system, it's not free of drawbacks. Some of the main gotchas include:

- The cost of the new gear. The RT devices aren't cheap. Fortunately, the 430EX III-RT is the first midrange wireless master, which helps. There are also third-party products on the market designed to be fully compatible with Canon's radio system, which are all much cheaper.
- You can have up to 15 separate Speedlite units in any radio wireless setup—one master and up to 14 slave units, regardless of flash group. This should be enough for most users, though the previous optical system has no such limits: any slave flash that can see the command from the master can respond.
- No EOS camera has an integrated radio transmitter at this time.
- Post-2012 "radio-aware" cameras (see next section) are the only ones that can use up to 5 separate flash groups configured any way you want. Older cameras that are not radio aware are stuck with the traditional 3 groups in the A:B C model.
- High speed sync. HSS in radio wireless mode is only available with post-2012 "radio-aware" models. This doesn't affect the same flash unit physically connected to the camera via the hotshoe, or when using optical wireless flash.
- Older cameras that are not "radio-aware" can't use high shutter speeds in radio wireless mode. Specifically, the maximum X-sync speed drops by about one stop.

11.11.3 Radio-awareness

Along with radio flash technology, in 2012 Canon also released the first EOS cameras designed to speak radio. The manuals refer to these as "EOS digital cameras released since 2012," which is awkward and inaccurate since one post-2012 model (the Rebel T5/EOS 1200D) has only partial radio support (radio settings must be set on the flash unit, not the camera).

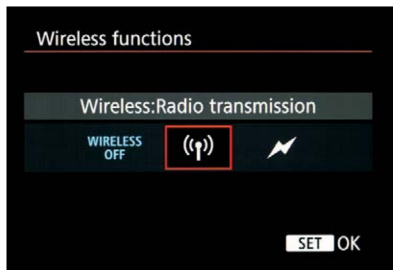
To clear things up I refer to the following three basic categories:

1. **"Radio-incompatible" cameras:** These are cameras that can't use radio wireless E-TTL at all. This includes nearly all film EOS cameras and the EOS 1D and 1Ds. E-TTL film bodies can only use Canon's radio wireless in manual flash or stroboscopic flash modes.
2. **"Radio-compatible" cameras:** These are digital EOS bodies released earlier than 2012. Since they predate radio E-TTL, they think radio-enabled Speedlites are optical ones. They *can* use radio wireless E-TTL, but have four specific limitations. First, they can't use radio groups. Second, they can't use high-speed sync (HSS) over radio. Third, their maximum X-sync is decreased by a stop when using wireless. And finally, even if they have menu functions for Speedlites (ESC) they can't enable radio-specific features.
3. **"Radio-aware" cameras:** These are EOS bodies specifically designed to support the full range of radio wireless E-TTL features. They support groups, HSS, modeling flash in radio mode, should have normal maximum X-sync, and have menu systems (ESC) that can control radio-specific features. EOS cameras introduced since 2012, except for the Rebel T5/EOS 1200D, are radio-aware. Note that radio E-TTL does not work if the camera is set to an icon mode—it has to be in P, Av, Tv, M, or bulb modes.

The categories listed above aren't official Canon names (though I think they should be!), but I use them here to help avoid confusion.

At time of writing in mid 2015, radio-compatible 2007–2011 cameras with menu control over Speedlites (ESC) are the EOS 1Ds Mark III, 1D Mark III, 1D Mark IV, 5D Mark II, 7D, 60D, 50D, 40D, Rebel T3i/600D, Rebel T2i/550D, Rebel T1i/500D, Rebel XSi/450D, Rebel T3/1100D, Rebel XS/1000D, Rebel T5/EOS 1200D.

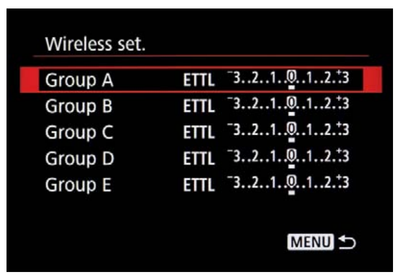
Radio-aware cameras are the EOS 1D X, 5D Mark III, and the EOS M-series (M, M2, M3).



11.62

11.11.4 Radio wireless groups

Canon radio wireless E-TTL can operate much like optical wireless, with two groups (A and B) controlled by ratios and a third (C) controlled by exposure compensation. But for more flexibility, radio-aware cameras have another option available to them: five completely separate groups, with independent metering systems (E-TTL II autoflash, manual, or external autoflash) for each one. You can then set exposure compensation (E-TTL II) or flash output (manual) for each group.



11.63

This feature eliminates one of the long-standing weaknesses of Canon's wireless system: the awkward A:B C ratio system. Unfortunately, at time of writing only radio-aware cameras can use this feature.

11.11.5 Channels, IDs, and flash clash

One problem with radio flash technology is that one photographer could accidentally trigger the flash units of another photographer nearby. In the case of optical wireless this is perhaps less of an issue, since you can probably see when someone else is inadvertently firing your flash units. But in the case of radio, which can pass through thin walls and travel great distances, the risk is much higher and troubleshooting is more difficult. Even worse are situations where many photographers are working a small area, such as a movie premiere or press conference.

11.64

Canon's solution for this problem is a "Radio ID" feature, which allows you to assign a four-digit ID number to each of your flash units. With up to 10,000 different ID numbers available, the chances of flash clash are lowered dramatically. There are also 16 radio channels available, and RT units can scan for other devices to determine which channel has the least interference. ☐ 11.64

11.11.6 Quantum Q-TTL


11.65

Quantum's Q-TTL system is the oldest radio-frequency wireless flash triggering system on the market today that supports automatic power output levels on Canon cameras. It consists of a number of different products that interoperate in various ways, all based around the FreeXwire transmitter.

Quantum has decoded the flash-related commands sent by Canon cameras and produces a hotshoe attachment, the Quantum TTL Adapter, which can interpret those signals. The attachment connects to the FreeXwire transmitter and sends flash sync and metering information by radio to FreeXwire receivers. These receivers can attach directly to the side of Quantum Qflash units. The radios use eight different frequencies and transmit up to 1,000 feet. Each flash unit can be in one of four zones, which can be turned on and off directly from the transmitter.

Quantum flash units are somewhat similar to Canon Speedlites in that they're battery-powered portable flash units, but they differ in that they have very high light output levels and require external battery packs. Instead of swiveling or zooming flash heads, they have bare flash tubes, protected by clear glass shields, to which various light-altering devices can be attached. They support simple metal reflectors, small softboxes, and other accessories. In short, they are high-output portable devices meant for professionals, such as wedding photographers. ☐ 11.65

11.11.7 RadioPopper PX

The RadioPopper PX, successor to the P1, takes an interesting approach to handling wireless signals. Instead of interpreting commands directly from the camera, the RadioPopper intercepts signals sent by a master Canon flash unit operating in optical mode. It reads those instructions, converts them to radio signals, and transmits them to a receiver. The receiver then sends the instructions back to the slave unit using infrared. Essentially the RadioPopper PX is a radio bridge or translation system, and thus it automatically supports all optical wireless E-TTL functions. □ 11.66

11.66

RadioPopper PX comes in matched transmitter/receiver pairs. The transmitter has a small pickup, like a tiny version of the coils used in electric guitars, which detects the magnetic burst produced by a flash unit when it fires. Its small fixed antenna sends commands using one of 16 separate radio frequencies. The transmitter must be fastened to the flash head of a Canon-compatible master device, such as any 500 series EX unit or the ST-E2, using tape or Velcro.

The receiver has no pickup, just a single, directional antenna that can be rotated to receive the signals from the transmitter. Additionally, it has an infrared diode on the back that plays IR signals back to a Speedlite. For all this to work, the receiver must be attached very carefully, since the slave won't respond if it can't see the RadioPopper's IR output. Also, if a slave flash unit receives optical signals from the master flash unit as well as radio-bridged RadioPopper signals from the RadioPopper receiver, things can get confused.

RadioPopper advantages

The strength of the RadioPopper system is that it fully and transparently supports all wireless E-TTL features without modification, since it's simply bridging the normal optical communications system used by the flash units. All 500EX and 400EX series Speedlites are supported, as is the ST-E2 transmitter. Attach RadioPoppers to a set of flash units and a very convenient automatic system becomes possible. No need to walk over to each slave unit to adjust its output: this can all be controlled from the master flash unit. The PX system has a good working range of about 300–1,500 feet.

Of particular note is that radio-controlled high-speed sync flash is possible, up to the camera's highest shutter speed. This was a technical innovation introduced with the original RadioPopper P1.

PX devices are small, lightweight, and easy to use. They allow for the convenience of E-TTL without short distance and line of sight restrictions. They can also work with sync-only RadioPopper JrX units. □ 11.67

11.67 A RadioPopper PX receiver attached to a 580EX II slave

RadioPopper limitations

The RadioPopper system's main advantage—a radio bridge to wireless E-TTL—is also its main weakness. It requires full wireless E-TTL capable master and slave units, making it expensive for hobbyists. It isn't intended for use with simple manual flash triggering, and can't extend E-TTL's

capabilities (e.g., second curtain sync is not supported). RadioPoppers can be used in conjunction with Nikon cameras and flash units, but note that all devices have to work on the same system—Canon E-TTL or Nikon iTTL. The RadioPopper can't translate Canon commands into Nikon commands or vice-versa, and cannot speak Canon radio wireless.

Another key point is that the small, flat RadioPopper boxes must be attached to sending and receiving flash units somehow. This can be done semi-permanently with double-sided tape, Velcro hook and loop fasteners, or an optional RadioPopper mounting bracket. Regardless of how it's done, the result is a small box that sticks out from the side of the flash unit. This can be a little awkward, particularly on flash units with curved fronts like the 580EX, and it can cause reliability problems if the RadioPopper receiver is bumped out of alignment with the wireless E-TTL receiver window.

The PX devices are fairly minimalist. Both components are small, light-weight, thin-walled plastic boxes. They have a very terse screen and input system, which consists of two seven-segment LED numerals, two LED lights, and two push buttons. Configuring the devices involves cycling through various two-letter menu choices, and it's essential to have the manual on hand to know how to work it. For this reason, it's best to configure and test the devices prior to a shoot. It also lacks a test button, which makes setup testing somewhat inconvenient. The RadioPoppers do not have any way for firmware updates to be uploaded. If the unit goes into P1 clone mode, for compatibility with a previous RadioPopper model, it can seem unresponsive.

RadioPoppers built for the North American market transmit from 902–928 MHz. This means they operate on the same frequency band as GSM-900 mobile phones used almost everywhere in the world except for North America and Japan.

11.68

11.11.8 PocketWizard ControlTL devices

The third radio transmitter system that supports power output levels is from LPA Design. Best known for its sync-only PocketWizard devices (section 11.10.1), the company has produced some highly programmable and compact hotshoe adapters that enable a wide range of advanced Canon E-TTL features wirelessly.

Like the Quantum devices, the ControlTL devices don't bridge E-TTL commands from a master flash unit, but connect directly to the camera and interpret the commands it would normally send to a flash unit. Radio waves are then used to transmit sync, metering, and other data. ❐ 11.68

11.69

At time of writing the product line consists of two devices: the MiniTT1 and FlexTT5. The MiniTT1 is a very compact transmitter, powered by a CR2450 lithium coin cell, which fastens to the camera's hotshoe. It has an integral antenna, a few switches and buttons, and a pass-through hotshoe attachment on the top, which connects to a flash unit's foot. The hotshoe allows for a flash unit and a MiniTT1 to be attached to the camera simultaneously if desired, but it does not let the unit act as a receiver. ❐ 11.69

The FlexTT5 is a noticeably larger device that can act as either a transmitter or receiver. Since it needs to sit and wait for radio signals when it's in receive mode, it's powered by two AA cells. The receiver connects to a camera via a hotshoe, adds a couple of sockets for controlling external flash units or remote cameras, and has a swiveling antenna.

Both devices are available in Canon and Nikon versions, but the two product lines are dedicated to one manufacturer only and do not interoperate or translate one maker's TTL commands to another's. The PocketWizard system is not compatible with Canon's wireless radio technology.

Basic features

Like other radio remotes, the two devices can be set up in simple master/slave fashion. The MiniTT1 attaches to the camera's hotshoe and transmits sync and metering data wirelessly by radio to the FlexTT5, which then commands any flash unit connected to it to fire. □ 11.70

11.70 MiniTT1 on-camera

Alternatively, one FlexTT5 can be used as a master and another as a slave. The system is compatible with many aspects of Canon's E-TTL; it supports flash metering, ratios, high-speed sync mode, and flash exposure compensation set on-camera. E-TTL ratios are supported, though they're referred to as "zones" and not "groups."

At time of writing, stroboscopic mode, flash bracketing (FEB), menu control of flash units, and some other functions are not supported by ControlTL devices.

Up to 26 different transmission frequencies are available to reduce the chance of channel conflict with another photographer's PocketWizard devices. The FlexTT5 can also be used to trigger a remote camera as well as a remote flash unit. There is also the AC3 device available, which makes it easy to set the output levels of different channels via rotating wheels.

11.71 PocketWizard AC3 ZoneController, which fits onto the MiniTT1 Transmitter or FlexTT5 Transceiver.

Compatibility with sync-only PocketWizards

The ControlTL devices can transmit on the same frequencies as regular sync-only PocketWizard devices. This allows photographers who have an investment in the older system to use the devices as sync-only receivers with a MiniTT1/FlexTT5 transmitter. Note that all devices must be designed for use in the same region in order to interoperate, for the regulatory reasons mentioned earlier.

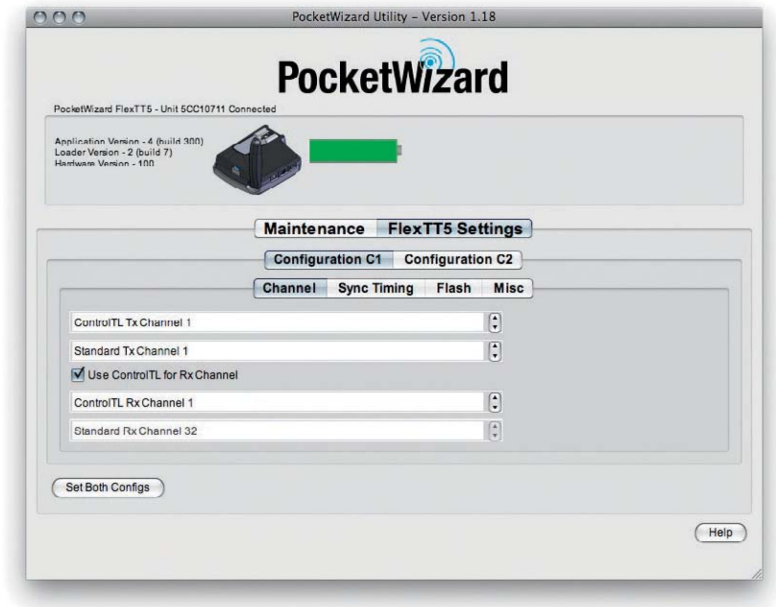
Manual output controlled by the 580EX II

When a 580EX II is connected to a ControlTL device's hotshoe, it's possible to control the manual output of three separate groups ("zones") of flash units. Power output is specified in fractions, not ratios as is normal for E-TTL.

Upgradeable via USB port

Devices such as the ControlTL are little computers driven by software. Many such hardware devices are difficult or impossible to reprogram, but the MiniTT1 and FlexTT5 have mini USB type B ports for connecting to a personal

computer. When LPA Design releases new firmware, it's easy for users to download updates from the Internet. The company has introduced a number of firmware updates that fix problems and add new features this way.



11.72 PocketWizard menu

Advanced features

Because they talk directly to the camera and flash unit, the ControlTL devices offer some interesting and unusual features. Most notable, perhaps, is the fact that the maker has released software upgrades that add a variety of new functions, such as more efficient high-speed and second curtain sync and more powerful preflashes (in addition to fixing other problems).

Higher efficiency sync

Normally, Canon high-speed sync flash starts pulsing the flash tube a bit before the shutter actually opens. The ControlTL devices, since they control the flash unit directly, have tightened up this flash trigger timing so that the tube begins pulsing closer to the shutter opening and closing times. This can mean increased high-speed sync output on some camera models, which translates to greater light output and decreased battery usage.

A similar trick is employed in the ControlTL version of second curtain sync. Flash timing is moved closer to the actual second curtain closing, resulting in less blurring at the front edge of a moving object.

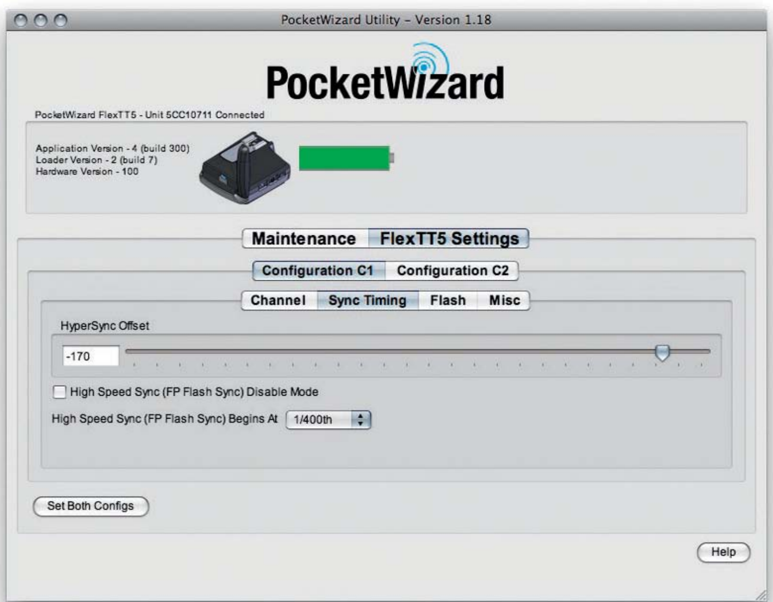
HyperSync

Perhaps the most interesting feature is a function called "HyperSync," which gives the ControlTL boxes the ability to exceed the camera's X-sync speed without using high-speed sync at all.

As noted in section 7.11, flash units can't expose the full frame of a focal plane camera if the shutter speed goes too high. The usual solution to the problem is to pulse a flash tube very rapidly, enabling high-speed sync. ControlTL devices support regular high-speed sync but add another way to exceed a camera's X-sync.

HyperSync takes advantage of the fact that the light produced by a flash tube drops off gradually if the tube is fired at full power. If fired at partial power, most battery-operated devices cut off power to the tube sharply, and the light drops pretty well immediately. But at full power, the light output has a long "tail" as it decreases. HyperSync fires the flash tube *before* the sync command is sent, and thus before the shutter actually opens. Then, as the light output gradually drops off, a full frame can be exposed at a high shutter speed.

HyperSync requires very precise timing over flash firing relative to the shutter opening, and each camera mechanism has slightly different time requirements. For that reason, the Windows or Mac OS X software included with the ControlTL hardware allows the timing to be adjusted in minute increments. Through trial and error, it's possible to squeeze the most performance out of each flash unit / camera combination, thus getting the highest shutter speed possible while maintaining full flash exposure and avoiding the black bar problem. It's also possible to specify the shutter speed at which the ControlTL device will transition from HyperSync to regular Canon E-TTL high-speed sync. ☐ 11.73



11.73

Range limits

The biggest weakness of the ControlTL system springs from one of its advantages. For compatibility, the devices transmit on the same frequency range as their predecessors, so they can trigger a Plus II or MultiMAX remote. Unfortunately, it so happens that certain Canon Speedlites emit radio-frequency noise in the same band when they fire. This noise is well within legal limits, but it interferes with the PocketWizard radio transmission. For this reason, ControlTL performance with certain Canon Speedlites is severely curtailed. Range may drop to 30–800 feet, compared to the 1,500-foot expected distance range from regular PocketWizard products.

The problem is severe with ControlTL units sold in North America, which operate on a frequency band from 340 to 354 MHz. Units sold in Europe operate at 433–434 MHz for regulatory reasons, and therefore have greater range. However, the CE-certified products are not available for sale in the U.S. and Canada.

The problem does not occur with non-ControlTL PocketWizard devices because they are usually situated a short distance from the flash unit when operating as receivers. ControlTL units, however, generally clip directly to the flash unit's hotshoe.

Various approaches to mitigating the effect of this interference are available, including using off-camera shoe cords to connect the receivers to the flash units (rather than connecting the receivers directly to the flash feet), adding noise-shielding ferrite clamps to these cables, or adjusting antenna orientation. But these measures obviously represent something of an inconvenience. The official PocketWizard solution is to provide a "sock" of noise-blocking metallic fabric, the RF Soft Shield, which can be wrapped around an offending Speedlite.

The Speedlites that produce the most noise, and thus have the shortest range, are the 430EX, 580EX, and 580EX II. The Speedlites 550EX, 420EX, and 430EX II produce the least amount of noise.

Not compatible with entire Canon range

ControlTL devices are not compatible with all Canon cameras and flash units. Specifically, they're compatible with most Canon digital SLRs since the 20D, and most Speedlite EX models and the ST-E2. Earlier cameras, including all film models, and TTL-only flash units are not supported.

11.74 Avoiding the hassle of wires, radio remotes are ideal for triggering flash units placed in unusual locations, such as this phone booth near the Royal Albert Hall in London. A high-powered Quantum Qflash unit was used, triggered by a FreeXWire radio remote. EOS 5D, 2.5 sec at *f*/8. ISO 100, 24mm.

11.11.9 Phottix Odin

The last system is the Phottix Odin. This is a 2.4 GHz radio system that offers full TTL support to remote flash units. It handles three separate groups, and you can apply flash exposure compensation to each one individually.

The product consists of an LCD-equipped transmitter that fits in the camera's hotshoe, and a small receiver for each slave unit. The transmitter lets you specify output channels at the press of a button. High speed sync through to 1/8000 sec is supported, and you can use manual flash output if you prefer. The product has a 300 foot/100 meter advertised range.

The Odin is very affordable, but is not compatible with Canon radio wireless. The Phottix Indra battery-powered flash unit (see 13.1.5) is compatible with the Odin. ☐ 11.75

11.75

12 Flash Accessories

Motorbike. An EOS 5D was attached to Floyd's motorbike handlebars using a Manfrotto Magic Arm and SuperClamp. He then drove through Oxford Circus, London, England. A 580EX II was mounted on-camera and fired in E-TTL mode with the diffuser panel down. Safety note: the setup was extensively tested on a motionless bike before proceeding, as a blinded motorcyclist is not something anyone would want. 0.4 sec at *f*/5 to ensure motion blur of the areas not lit by flash, ISO 100, 17 mm.

Both camera shops and the Internet are filled with countless flash accessories vying for your attention. Some of these things are indispensable; others could be charitably described as possessing limited value. This section describes some of the more interesting light-modifying add-ons for small portable flash units.

Most of these accessories do one basic thing: enlarge the surface of the light-producing area relative to the subject. This softens and tames the harsh light of flash, as detailed in the chapter on basic technique. Some of the other accessories restrict the light or alter its color.

So, are these accessories useful? The answer is a qualified yes. They can definitely help in specific situations, and many have a following in the professional market. But they're not a panacea for all flash problems. There's no such thing as a universal magic accessory that covers all situations. Simply slapping a plastic tub onto a flash unit won't automatically yield awesome photos. An on-camera flash unit, with accessories or not, is no substitute for skilled use of off-camera flash.

A key point is that flash compensation normally doesn't need adjusting when using a diffuser in any automatic flash-metering mode that works through the lens. Your camera will adjust automatically for the stop or two of light that the diffuser soaks up, to the output limits of the flash unit. Of course, when using manual flash metering mode, you'll need to factor in the reduced light output manually through testing.

Another key point to remember is that diffusers behave differently when used in different spaces. A common trap for beginners is to test out a new diffuser at home in a white-painted living room, then use it in a vast wedding hall. The reflective properties of the room are critical to the way most diffusers work.

This is important when viewing the sample photos in this book. Most were taken in a small studio with light-colored walls. Therefore, they won't accurately convey the results of taking a photo with a given product in, say, a large hall. This chapter is a guide, but always research these items before buying them yourself.

12.1 The diffuser for a 430EX III.

12.1 Flash diffusers

There are all sorts of add-on light-diffusing attachments that clip or tape onto the flash head. They usually cost a stop or two of light, easily halving the range. They come in two basic flavors: small diffusers and small panels.

12.2 Small diffusers

Small diffusers don't really enlarge the size of the light source, and so can't, in themselves, soften the light very much. What they actually do is redistribute the flash unit's light output so there's more light scattering around,

bouncing off walls and ceilings and so on. They help to reduce the “black hole” effect of flash photography by distributing light more evenly and thus providing illumination to the background. They also soften the light a little on foreground subjects.

Small diffusers are best suited for modest interior spaces or for macro photography shots without a macro unit. They’re less useful when shooting outdoors or in dark interior spaces, where there’s no way to bounce the light. In such situations they simply cut down usable range, waste power (meaning batteries and money) and increase flash cycle time. They’re also problematic when the walls or ceilings are painted bright colors, as the light bouncing off those surfaces will take on a color cast. Small diffusers also offer less control, as they just basically spray light around. But all this aside, they can be very useful, particularly for fast-moving journalist or wedding situations.

12.2.1 Sto-Fen Omnibounce

Milky white, open-ended plastic boxes that fit snugly over the flash head, Omnibounces approximate the way bare tube studio lights radiate light outwards in a near sphere. For this reason they’re very useful with wide-angle lenses. ☐ 12.2

Photojournalists often have these accessories permanently fastened onto their flash units, since they can help even out the spread of light when used indoors. Yellow and green versions are available for tungsten and fluorescent lighting. Because of their tight-fitting design, Omnibounces are made specifically for each flash unit model and aren’t available in generic one-size-fits-all versions.

Recognizing the popularity of these accessories, Canon now includes very similar diffusers with the 430EX III/430EX III-RT and 600EX/600EX-RT flash units.

12.2 Sto-Fen Omnibounce

12.2.2 Gary Fong Lightsphere

The Lightsphere is a heavier and larger diffuser that is popular with wedding photographers. Because a big device such as this puts out more light, and because its significant bulk and weight can be a problem for the hinges on smaller flash units, it works best with larger hotshoe flash units. The model shown here is of cloudy white plastic, though more specular versions made of clear plastic are also available. These accessories attach onto the end of a flash unit using fabric straps. ☐ 12.3

12.3

12.2.3 Demb Flash Diffuser

This product consists of two layers of translucent plastic attached via rivets to a strap, which allows the diffuser to be tilted forward or back to govern the amount of light hitting it directly from the flash head. It's designed to be used in conjunction with the Flip-It! reflector in the next section, though it can also be used alone. ☐ 12.4

12.4

12.2.4 Speedlight Pro Kit Flexi Bounce

This fold-out diffuser, from Speedlight Pro Kit, combines a translucent diffuser made of flat polypropylene sheeting with three stippled reflective silver reflectors. The result is a device that reflects some light forward and causes the rest to bounce outwards. When used in a small to average-sized room with neutral-colored walls and ceiling, the light will bounce around and will reduce the black hole effect. It isn't particularly sturdy when in use. ☐ 12.5

12.5

12.2.5 Harbor Digital Design Ultimate Light Box

This modestly named translucent plastic box fastens to the end of a flash unit's head, so it must be bought with the correct attachment mount for a given unit. It's like a large Omnibounce with detachable components such as a color filters and a black plastic box to restrict side bounce and direct more light forward. It's reasonably flexible, but the main box is bulky and awkward to pack when traveling. ☐ 12.6

12.6

12.3 Small reflectors

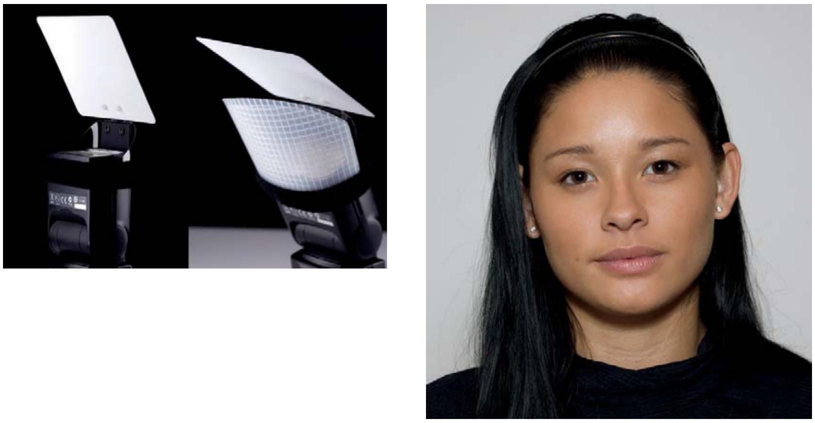
Reflectors enlarge the surface area of the flash a small amount, but also reflect light towards any nearby wall or ceiling. They're adjustable on small hinges, which allows a good deal of control. The reflectors can also be mounted on the long edge or the short edge of the flash head, depending on the orientation of the unit relative to the subject and the desired reflected

direction. They don't work so well outdoors or in a large dark room, where they soften the light on the foreground somewhat but do little to affect the background.

12.3.1 Demb Flip-It!

The Flip-It! is one of the oldest products in this market, dating back to the 1990s. This panel, white on one side and black on the other, straps onto the top of a flash head with Velcro and is on a movable hinge. This allows more or less light to be reflected forward at any arbitrary angle. It easily attaches to either the long side or the short side of a flash head. A Flip-It! is shown here with the optional Demb Flash Diffuser. ❑ 12.7

12.7



12.8

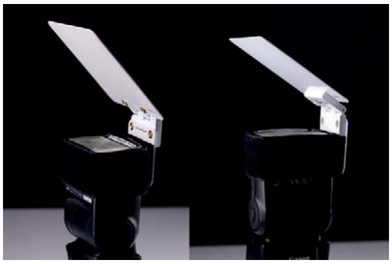
12.3.2 PRESSlite VerteX

This accessory ships as a small bag of components that must be assembled before use. It differs from the other two reflectors in that it has two separate halves that can be tilted independently. One side can reflect light forward, for example, while the other reflects light upward. One half can have a white matte card installed, and the other a mirror-like silver sheet.

It's versatile, but at a cost: it takes some practice and fiddling to understand the ways in which the device reflects light, both directly and off nearby surfaces. When shooting, you have to stop and think about how light will reflect off the current surroundings. ❑ 12.8

12.3.3 Hanson Fong Skin Glow

This accessory (unrelated to Gary Fong products) is a double-sided reflector. It's similar to the Flip-It!, but one side is pure white and the other is colored a subtle warm tint. It has a slightly wider hinge, which is sturdy but also difficult to fasten to curved flash heads like the 580EX II. It is shown here attached with a Honl Speed Strap in both long side and short side positions. ❑ 12.9



12.9

12.4 Medium-sized reflectors and diffusers

These mid-sized reflector panels essentially enlarge the light output area of the flash, softening the edges of shadows. Unlike small devices, these larger accessories are less reliant on white surfaces to bounce light and so are of more value outdoors or in dark churches, large banquet halls, and so on. However, they're meant for close-range shooting—they won't help much when taking pictures at a distance and indeed will hinder the process, as they cut the range of a flash unit by at least half. After all, a mid-sized panel some distance away becomes a small light source relative to the subject. ☐ 12.10

12.10 A classic difficult situation for a photographer: an aisle shot taken in a large abbey with a high, dark ceiling. There were no surfaces for bounce flash, and it was too dark to rely entirely on ambient light. Since things were moving rapidly, and a large reflector on a stand wouldn't work, a flash unit with a Lumi-Quest Quik Bounce was used.

12.4.1 LumiQuest Quik Bounce

This scoop-shaped vinyl device is angled forward slightly to catch most of the light thrown upwards by the flash head. It thus increases the area of the light-producing surface. It attaches to a camera's flash head with the usual Velcro strips, or as shown here with a Honl Photo Speed Strap.

For a portable reflector, the Quik Bounce is reasonably large and offers a decent surface area for portrait shots, though it does tend to stick out vertically quite a bit. It has a pair of flaps that can be held open with Velcro, and which allow more light to escape upward for situations where you can use bounce flash; though the flaps can tear easily. ☐ 12.11

12.11

12.4.2 LumiQuest Softbox III

This is a collapsible, vinyl, pyramid-shaped accessory that fastens onto the flash head with double-sided Velcro tape. It has a double-thickness oval patch in the center to reduce the hotspot effect caused by proximity to the flash head. The Softbox III is shown here attached to a Honl Photo Speed Strap, to avoid the messiness of Velcro tape. It's effective for close-range work, though a little heavy for its size. It also blocks a flash unit's autofocus assist light when directed forward, as it normally would be used. It flattens to a thin square for easy transportation. ☐ 12.12

12.12

12.4.3 Westcott Micro Apollo

This diffuser is essentially a fabric bag with a folding metal frame. It has a white fabric front and silver-lined black sides to reduce spill. The frame has Velcro attachments so it can fasten to the sides of a flash head. It's fairly lightweight, sturdy, and folds flat for easy transport. It expands the size of the light-producing area, but only to about the size of a paperback book. Since it directs all its light forward, it's intended for close-range use in portraiture. It's awkward to use compared to similar add-on panel devices.
☐ 12.13

12.13

12.4.4 Speedlight Pro Kit Reflectors

This is pair of reflectors (the 4 model and the 6 model) that ship as flat-pack kits containing numerous wedge-shaped panels. Their flat sides clip together to form pyramid-shaped flash diffusers. Notably, the reflectors can be accessorized with corrugated plastic grids and the like as they direct all their light forward. They break down easily for packing, but can easily come apart as the adhesive ages. ☐ 12.14

12.14

12.4.5 Generic vinyl diffuser

This cheap, semi-transparent bag, bought from an Internet auction site, is frankly useless and makes no difference whatsoever in the quality of light. It does, however, amuse onlookers who may ask what the inflatable pillow is for. ☐ 12.15

12.15

12.5 Large portable diffusers

Large diffusers offer softer light solutions but generally with less portability than small modifiers. Many are smaller or stripped-down versions of the light modifiers used in studios.

12.16 This picture was taken in direct sunlight with a California Sunbounce reflector positioned camera left. Note that a gold and silver striped surface faces the model for a slightly warmer color of light.

12.5.1 Umbrellas

Umbrellas, the classic solution for increasing light-producing surface area in order to soften the light, come in a variety of sizes. They can be reflectors (silver umbrellas that reflect the light from a backward-facing flash unit onto the subject) or diffusers (translucent "shoot-through" umbrellas that spread the light from a forward-facing flash unit). Most are intended for studio use, but some collapsible models are particularly useful for location work. Collapsibles have struts that fold in half, making them quite small and portable.

Consider the photograph of ancient Noh theatre masks at the start of chapter 9. These masks were lit with a Speedlite bouncing off a collapsible silver umbrella. They would have been better lit by a softbox, as light hotspots are visible in shiny areas, but the portability of the umbrella meant it was possible to take these images on location at a private Noh theatre in Tokyo. ☐ 12.17

There is an important point about using a portable flash unit with an umbrella. In the photo below, the flash head has not been set to cover the entire surface area of the umbrella, which can lead to a hotspot, or brighter area in the center. This may be intentional, or it may be better to zoom the flash head out to provide more even coverage.

For more details on umbrellas, please consult section 13.4.2.

12.17

12.18

12.19

12.5.2 Umbrella brackets

Umbrella brackets are simple metal or plastic brackets for attaching a Speedlite-type flash unit and an umbrella to a light stand. These tilting brackets have small holes with thumbscrews to fasten the shaft of the umbrella, and a cold shoe on the top for the flash unit. ☐ 12.18

There are also more flexible ballhead brackets made entirely of metal, which let the flash point in any direction but which can't accommodate as much weight. ☐ 12.19

12.5.3 Lastolite Ezybox

This portable fabric softbox pops open from a flat disc form, somewhat like a self-standing tent. It has a metal ring at the back to which a portable flash unit can be attached, though there's no light seal around the edges of the opening. This softbox is ideal for positioning a soft light source close to a person's face for on-site portraits. It's somewhat larger and heavier than most of the previous accessories, but its larger surface area means it can provide a much softer form of light. ☐ 12.20

It has an optional extending handle for handheld use, though this is awkward without an assistant and a light stand may be easier when shooting solo. The hotshoe attachment takes a little practice to use effectively, though it has the advantage of leaving the flash unit's controls fully accessible.

12.20

12.5.4 Westcott Mini-Apollo

The 16-inch Mini-Apollo is a sort of hybrid between a softbox and an umbrella. It has a flat fabric diffuser front like a softbox (only one layer of white fabric), but collapses like an umbrella for easy transportation. It's a lightweight and portable solution for improving flash quality. ☐ 12.21

Unfortunately, the Mini-Apollo is a little awkward to set up and use. It has a loose-fitting metal rod between the umbrella shaft and the flash unit that tends to wobble. The flash unit controls are not accessible without

removing the diffuser fabric, so it's vital to disable auto power-off. Oddly, the instructions show the flash unit facing forward, which defeats much of the purpose of a softbox. Facing backward loses power but increases the softness of the light.

12.21

12.5.5 Westcott Recessed Front Apollo

The 28-inch Apollo is the Mini-Apollo's much bigger brother. It's also a square softbox design with an umbrella frame, so it takes up very little space when collapsed. ☐ 12.22

Unlike its smaller sibling the 28-inch Apollo relies on a fairly standard umbrella bracket to support a flash unit, avoiding the loose support system of the Mini-Apollo. This design is fairly sturdy, though it has the drawback of positioning the flash head high and off-center. ☐ 12.23

12.22 A pair of Apollo softboxes in their collapsed form: the Mini-Apollo is on the left, and the 28-inch Apollo is on the right.

12.23 A Westcott Recessed Front Apollo with the diffuser cloth rolled up in order to show the interior.

Given its size, this modifier really needs a high-powered flash unit to work effectively. In fact, it's roomy enough to accommodate up to four battery-powered Speedlite-type units, given proper mounting brackets such as those from Denis Reggie (two-way) and Lastolite (three-way). This allows for highly portable softbox lighting with full support for high-speed sync.

12.5.6 Westcott Rapid Box Octa and Strip

These collapsible softboxes offer an interesting design, partway between an umbrella and a softbox. They have sturdy frames and open instantly, and they provide a large area like a softbox. They come with heavy duty brackets. Note that since the flash shines inside the softbox from the back, it isn't compatible with an Off-Camera Shoe Cord or anything that moves the flash unit up off the shoe. ☐ 12.24 and 12.25

12.24

12.25

12.5.7 Roundflash Dish

This is a large flat cloth cone that attaches to the end of a Speedlite, turning it into a beauty dish with a fabric front. It has a fairly large area at the center with a black panel, so I'd say it has a smaller illuminated area than most beauty dishes I've seen. Folding up neatly as it does, it's considerably more convenient and is a lot more portable than a large metal dish. ☐ 12.26

12.26

12.5.8 California Sunbounce Micro Mini

The Micro Mini, from German maker California Sunbounce, consists of a lightweight H-shaped metal frame over which reflective fabric is stretched. An adjustable arm holds the flash unit, which bounces light off the fabric

onto the subject. A sturdy and well-engineered reflector, it rolls up into a reasonably compact, though somewhat long, bundle.

The primary advantage of the reflector is that light is bounced back off a relatively large surface area, making the light very soft for portraiture. Its primary drawback is its size and its propensity to catch the wind like a kite when outdoors. It's shown here attached to a light stand with a Manfrotto Superclamp, but it's also designed to be held by an assistant—or by you singlehandedly, if you can operate the camera with the other hand. ☐ 12.27

The name "Micro Mini" might seem a little strange for one of the largest products in this section, but that's because Sunbounce specializes in large professional products for commercial photography and TV and film production. By comparison, this reflector is small in their line of products. The model shown here has a silver-white surface on one side for neutral lighting and a gold-silver zigzag stripe ("zebra" pattern) on the other for warmer light.


12.27 The California Sunbounce Micro Mini

12.28

12.6 Other flash accessories

In addition to devices for softening light output, there are various accessories available that can modify or shape light in different ways. These tools perform very different functions.

12.6.1 Honl Photo Speed Strap

Most add-on flash accessories require Velcro adhesive strips to be added to the sides of the flash head, which look messy and leave a sticky residue. The Speed Strap is a way around the problem. It's a pressure/friction fit rubber and Velcro strap that can be put on and off without any sticky mess. One minor drawback is that it has a rubber tag with the manufacturer's label that can get in the way of some flash attachments. Nonetheless, it's a flexible solution that's compatible with most of the add-on accessories in this section. ☐ 12.28

12.6.2 HonlPhoto Speed Grid

This plastic grid fastens onto the end of a flash unit with a required Speed Strap and restricts the output of a flash unit to a narrow pool. Two versions are available: one with a 1/4" grid and one with a 1/8" grid. The latter offers a smaller area. While a useful accessory, the grid is larger than most portable flash units and thus doesn't fit neatly over the head. ☐ 12.29


12.29


12.30

Note how grids work. They essentially direct a beam into a straight line by blocking sideways reflection. Figure 12.30 shows a pair of grids straight on and at a slight angle, showing how effectively they block off-axis light.


12.31

12.6.3 Speedlight Pro Kit snoot with honeycomb

This unassuming grid is made of layers of corrugated plastic inside a rectangular sleeve. While rather low-tech and reliant on tape, it's lightweight and convenient to use—a bit less crush-resistant than the Speed Grid, but quicker to attach. The grid section can also be moved within the sleeve for limited adjustment. ☐ 12.31


12.32

12.6.4 Honl Photo snoot

A snoot is just a cone or cylinder that attaches to a flash unit and restricts light to a narrow area. Studio flash snoots tend to be metal cones, but Honl-Photo products are fabric panels. They attach to the flash head using Velcro and can be shaped into cylinders or cones as required. Simple, but versatile and useful for keeping light away from areas it shouldn't be illuminating. ☐ 12.32


12.33

12.6.5 Rogue FlashBender

This accessory is conceptually simple—it's a rectangle of reflective fabric with some internal wires for bracing. The result is a flexible panel that can be bent and shaped, reflecting light as you require it (section 7.22.2). It straps to the side of the flash unit, has various optional accessories such as a fabric grid, and can fold up for travel. ☐ 12.33

12.34

12.6.6 Walt Anderson Better Beamer flash extender, from Arthur Morris / Birds as Art

Very few flash units are able to zoom farther than 105 mm, so they scatter and waste a lot of light when used with very long focal length lenses. This can be a problem for nature photographers and others who habitually use telephoto lenses. At the distances they shoot, every drop in flash power is important.

The Better Beamer is a Fresnel lens mounted on a lightweight folding frame that attaches to a flash head with Velcro. The extender concentrates the light from the flash tube, giving more reach when using telephoto lenses 300 mm or longer. They're invaluable for nature photographers who want a little fill flash for wildlife located a considerable distance away. The Better Beamer packs down to flat components for easy portability. ☐ 12.34

12.7 Ringflash adapters

Ringflashes are ring-shaped flash units that fit around the end of a camera lens. They can be fairly small and low-powered, such as those used for macro photography (the Canon MR-14EX II is a typical example), or they can be large studio units (section 13.1.3).

Studio ringflash is commonly used in fashion photography, yielding a characteristic flat look, with no shadows on the foreground subject. Subjects lit with ringflash also tend to cast a signature dark halo shadow onto background surfaces. Ringflashes are expensive, large units. Macro flash units are portable but don't offer much light output.

A number of companies have introduced light-guiding adapters that transform an ordinary shoe-mount flash unit into a ringflash. These adapters fit around the lens and contain various reflectors and baffles to provide a reasonably even light output. Neither is a full substitute for a true ringflash, but they do offer relatively flat and shadow-free on-axis lighting for portable situations. They're just somewhat awkward to use. ☐ 12.35

12.36

12.7.1 Ray Flash

The first ringflash add-on commercially available, this unit requires a 500/600 series flash unit attached to the camera's hotshoe. The adapter fits onto the end of the flash head and angles downwards 90° to the ring itself. ☐ 12.36

There are no supporting structures to keep the ring parallel to the image plane, so it tends to sag a little inwards from the weight. The adapter must be matched to a specific flash model—a single adapter won't fit all flash units. The unit costs a bit over a stop of light.

It works reasonably well, though the weight of the device does seem to put some strain on the flash unit's hinge. It also blocks the AF assist light on the front of the flash unit, making it very difficult to use in low-light situations.

12.35 This photo was taken using an orbis ringflash adapter. Note the flat lighting and the characteristic dark halo around the model. Color was desaturated for a vampiric look.


12.37

12.7.2 orbis

The orbis adapter is similar in concept but different in execution. The adapter slides directly into the flash unit, which does not sit on the flash shoe. Instead, the adapter has to be held by hand around the lens, though the company does sell an optional bracket. □ 12.37

The primary advantages of the orbis are that less light is lost down a vertical tube of plastic, and the adapter does not block the flash unit's AF assist light. However, these advantages may be somewhat theoretical, as the orbis doesn't seem that much brighter than the Ray Flash. Also, the latter point is fairly moot since the whole rig must be held at a very specific angle for the AF light to line up properly with the focus points.

The orbis is a bit trickier to use off-tripod, since both hands are busily occupied holding things. If necessary, the flash unit could be attached to a light stand and mounted vertically, which would make things a little less cumbersome. Its light also has a notch cut out of the end where the flash unit attaches, so it doesn't project a perfect circle, and this can be seen in the catchlight of an eye.

12.38

12.7.3 Roundflash

The Roundflash takes a completely different approach from the other two, as it doesn't have a hard plastic shell. It's basically a fabric softbox ringflash, which means it's much larger than the other devices in operation, at about 45 cm or 18 inches in diameter. This makes it fairly awkward and bulky once it's set up, so it's less suited for roaming around parties and so on, but it packs down to a tiny fabric bag for transportation. □ 12.38

It actually opens up very quickly due to its popup design assisted by ingenious magnetic rods. It can also be used as a flash modifier without a camera inside, sort of like a round softbox or diffused beauty dish.

12.8 Filter gels

The most common and affordable filters for light sources are paper-thin flexible plastic sheets known as "gels." In years gone by, gel filters were made from animal gelatin, hence the name. Today, gels are made from sheets of polyester or polycarbonate, and they come in a dizzying variety of colors. They aren't optically perfect like filters intended for lenses, because they're tools for modifying light output.

Gels are usually sold in rather large sheets. They're commonly used for theatrical and cinematic lighting, where the sheets are placed in front of large hot lamps. Gels have a pretty short lifespan when used in this way, since continuous lighting will fade or even melt gels quite rapidly. Flash is usually less stressful to the filter dyes and material, as flash bursts are so short, but gels still need to be replaced from time to time in situations where precise color accuracy is needed.

Larger flash units, such as studio flash, require big gel sheets cut to size. Since portable flash units are much smaller, huge gel sheets are kind of overkill. A great way to alter the light color from a small flash unit on the cheap is to go to a theatrical lighting store and pick up a gel swatch booklet, such as these from Lee Filters and Rosco Laboratories.

Swatch booklets are bound collections of gel filter samples—each coincidentally just large enough to cover the lens of a typical small flash unit—with paper slips describing the exact lighting properties of each gel. The booklets were once available for free, but usually cost money these days. Shops and filter-makers got kind of tired of subsidizing their use on small flash units. ☐ 12.39

12.39

12.8.1 Gel holders

Only the Speedlite 600EX/600EX-RT has a built-in filter holder. On other models you need either strips of Velcro, bits of gaffer tape, or some sort of holder to hold the gels in place. Here are three filter holders for small battery-powered flash units.

LumiQuest FXtra

The LumiQuest FXtra is a vinyl filter-holding pouch that attaches to a flash head using adhesive hook and loop tape. It includes a small storage flap that can hold additional rectangular filters, and the product ships with a useful basic selection.

The holder is a great way to change the color of the flash in moments. The primary drawback is that it isn't wide enough to fit larger flash heads. The diffuser panel bulge on the top of the 580EX II, for example, prevents the FXtra from fitting properly. It's also easy to crease the filters, as it's tricky to slide them into the tight clear filter holder. ☐ 12.40

12.40

HonlPhoto Filter Kit

The Honl filter system takes a different approach in that it doesn't use rectangular, sample-sized filters. Instead, it's a collection of Lee gel filters cut down to size and equipped with hook and loop strips. These strips are intended to fasten onto a Honl Photo Speed Strap, which is not included.

The filters curve over the head, as shown here. They don't look great, but they offer full coverage of the flash head and easily fit any common portable flash unit. No carrying pack is supplied. ☐ 12.41


12.41

GelHolder.com

The Gel Holder is a piece of clear acrylic plastic, folded permanently into an L shape. It attaches to a flashhead using hook and loop fasteners, and can also attach to other products such as the Honl Photo Speed Strap.

The Gel Holder is designed to contain a sample-sized gel sheet. Its hard surface nicely protects the gel, and it's easy to slide the gels in and out. It is a simple design, though one that lacks storage options for carrying gels

12.42

12.43

12.44 This experiment in cheesy 1990s hacker imagery, with its absurd projected text that never happens in real life, was surprisingly complex to light.

A 430EX III-RT, on a long shoe cord, was camera left and gelled green. It served as a radio master for a 600EX-RT camera right, which projected green text using a Light Blaster. To the right was a sheet of black card stock with holes. Clear push pins and red and yellow gels, backlit by a gridded flash, simulated an LED-covered panel. Two other studio units, one gelled blue, lit the background. The reflection of the screen in the mirrored shades took an additional 1/4 sec exposure once the flashes had fired.

around. Sadly, it doesn't fit flash heads with curved tops, such as the 600EX, very well at all. ☐ 12.42

600EX/600EX-RT

As noted above, the 600EX/600EX-RT is the first Canon Speedlite to ship with an optional add-on filter holder (section 7.19). It's designed to accept only custom-shaped Canon filters, unless you make your own with some gel material and a pair of scissors. Note that if you add your own filters you'll want to disable the flash unit's filter-detection feature, which is designed to work solely with Canon color filters.

12.9 Flash projector

People have long used projectors of various kinds to shine photographic images onto backgrounds. A common technique for special effects photography in the days of film, it can also be done with static photography. However, it requires a lot of light—even a normal slide projector can require fairly long exposures. The Light Blaster is an attachment that lets you project images from slides using a flash unit, avoiding the long exposure problem. You can easily hack together something like this yourself, as it's just a lens mount and bracket so you can use an ordinary 35mm camera lens to project the image, but the Light Blaster is much more convenient.

The two main uses are projecting a picture or pattern onto a subject, or projecting an image on a wall or screen behind the subject (see example on page 322). If you don't have any appropriate slides, there are companies that can make 35mm film slides from your computer files.

12.10 Do it yourself!

Many of the products listed are used by professional photographers. For pros, time is money. They need convenient and reliable solutions that work the first time, and a photojournalist might be a bit self-conscious gaffer-taping a cereal box to a flash head in front of a paying client. A lot of effort goes into designing a solid product, but most hobbyists have the luxury of time for experimentation, and they have less money to burn. There's no need to impress anyone, so experiment and be resourceful!

A box lined with foil for a reflector. Black straws stacked together to make a grid. Plastic pipes and white nylon fabric for a diffusion panel. A salad bowl for a beauty dish. A translucent milk jug for a small diffuser. Cardboard and black gaffer tape for a flag. A Fresnel reading magnifier to extend a flash unit's reach. And the classic white index card rubberbanded to a flash head for a bounce card. These homebrewed light-modifying solutions may not be terribly rugged, but they may produce results similar or equal to expensive commercial products. □ 12.45

Most traveling photographers also have their own favorite solutions for mounting flash units on location. Some screw coldshoes to sturdy painter's clips. Some use thin-bladed palette knives or trowels and slide the metal piece in a doorframe or a shelf. And then there's the infinitely flexible human (voice-activated) light stand... ask an assistant or a passerby to hold the flash for you.

12.45

12.11 Supports

There are countless ways to mount and attach battery-powered flash units. Here are some common accessories to do the job.

12.11.1 Plastic foot stand

Inexpensive plastic stands are included with all slave-capable Speedlites. They're nothing more than a plastic base with a slide-in bracket, but they are effective for resting a remote flash on a flat surface. They can be stored in the flash unit's carrying case. Extra stands are readily available from Internet auction sites at very low cost. □ 12.46

12.46 A Sigma flash unit on its stand

12.47 A pair of Manfrotto Nano light stands

12.11.2 Light stand

Light stands are telescoping metal supports for lighting equipment. They come in a variety of heights and sizes, usually consisting of a central column with three folding legs located some distance down. This design makes them less sturdy and more prone to wobbling than camera tripods, but also makes them more portable. It's easy to attach a cold shoe to the top of a small stand for a convenient, portable solution. ☐ 12.47

Most light stands are fairly large and heavy affairs, but Manfrotto Nanos have legs that fold upwards into the main shaft, resulting in a very small and portable unit. They're only 19" long when folded, yet can reach six feet when fully extended. Stands like this are a mainstay of photojournalists who need lightweight, portable equipment.

12.11.3 Joby Gorillapod

12.48

The Joby Gorillapod is engineered with an ingenious set of three flexible jointed plastic arms. The plastic "tentacles" can be wrapped around any convenient object, allowing cameras and flash units to cling to all manner of things. Shown here is the Gorillapod SLR model with optional add-on flash shoe, which can support the weight of this Speedlite 580EX II. Smaller versions support pocket cameras, and larger Gorillapods can handle even SLRs.

They're particularly useful when working outdoors, where there are often few convenient flat or even surfaces. With a Gorillapod, a camera or flash unit can grip onto a tree branch quite easily, though they can't reliably support the weight of a flash unit with a heavy modifier, like a softbox. ☐ 12.48

12.49

12.11.4 Justin Clamp

Figure 12.49 shows a Manfrotto "Justin" clamp (named after Justin Stailey, who designed it for photographer Joe McNally). It's a metal clamp with rubber pads along its jaws and a tiny ballhead topped with a coldshoe. The clamp also has a 5/8" stud on the side.

The clamp allows a flash unit to be attached to all kinds of surfaces—tables, doors, shelves—and the ballhead lets it point in any direction required. Very versatile, especially for indoor shoots, though the awkward size and shape means it's a little bulky for traveling. ☐ 12.40

12.11.5 Magic Arm

A Manfrotto Magic Arm is an indispensable piece of equipment for location photographers and filmmakers. It's a sturdy articulated metal arm with screw-in points for clamps and brackets. It may be overkill for the typical flash unit, but it can be used in countless ways. The motorcycle shot at the start of this section, for example, was taken using a camera fastened to a MagicArm. □ 12.50

12.50 A Magic Arm with optional flash hotshoe attachment.

12.11.6 Kacey pole adapter

Painters and window washers use very long, sturdy, telescoping metal poles in their line of work. On the end of these poles is a standard tapered broom handle thread, onto which they attach paint rollers, squeegees, and other tools.

These poles haven't gone unnoticed by photographers, who are always looking for ways to put cameras and light sources into new and interesting places. Such poles can serve as a high-vantage-point camera mount and can yield some interesting shots. They aren't perfect, as the poles may flex; therefore, high shutter speeds are needed.

Cameras aside, they're often used for attaching flash units so you or an assistant can carry around a portable light source up high. The Kacey pole adapter was designed for this. It's simply a turned piece of aluminum with a broom handle compatible socket on one end and a 5/8" stud for a flash unit umbrella mount on the other. (Unfortunately, it lacks a 1/4" thread.) □ 12.51

12.51 A Magic Arm with optional flash hotshoe attachment.

12.11.7 Flash brackets

Large metal brackets for attaching flash units to a camera are popular with wedding photographers and the press for reducing the redeye effect. However, they serve other purposes as well. □ 12.52

12.52 The 600EX is one of the few flash units with a special socket for attaching Canon's Speedlite Brackets.

By raising the flash above the lens, ugly flash shadows cast onto walls behind a subject are less visible. The shadows are still there; they're simply below the subject and so may not appear in the final picture. Many flash brackets also have rotating attachments that keep the flash centered above the lens at all times—rather than having it on the side when taking photos in portrait orientation rather than landscape. This can involve flipping or rotating the camera rather than the flash unit.

The primary drawbacks of flash brackets are that they're very large and cumbersome. They transform a camera into a gigantic rig, which can frighten human subjects or make them feel much more self-conscious than they would normally. Another drawback involves AF assist lights. A flash unit raised off the camera may have an assist light that, due to simple geometry, no longer lines up correctly with the camera's focus points.

Canon makes the Speedlite Brackets SB-E1 and SB-E2 for use with 430EX/II, 580EX/II, and 600EX/600EX-RT flash units only. This simple horizontal bracket attaches to the mounting socket on the side of those flash

units, providing sturdy and secure two-point mounting. The SB-E2 includes a weatherproof off-camera shoe cord. The SB units have no rotating function and position the flash unit to the side of the camera, not above it, making them more suitable for portrait use than landscape.

12.53 From left to right, a Stroboframe Quick Flip 350, a Custom Brackets Digital Pro-M, and a Canon Speedlite Bracket SB-E2. The Quick Flip allows the flash unit to be rotated above the camera. The Digital Pro-M takes a different approach; the flash remains stationary and the camera turns on a rotating bracket. The Canon Speedlite Bracket is compact but has no provision for flash unit or camera movement. It also requires a special mounting socket, which many Speedlites lack.

12.12 Batteries

While not really an accessory as such, the humble battery is a vital consideration with any electronic device. After all, dead batteries transform a working tool into a useless paperweight. Most Canon flash units use four standard AA (variously known as penlight, R6, and most bizarrely, mignon; French for “cute”) cells.

Of the various battery chemistries available, NiMH and NiMH hybrids are by far the best choice. Disposable batteries are costly over time, and more importantly, are unnecessarily wasteful and harmful to the environment. A set of NiMHs with a good charger has a higher initial investment that will pay for itself over time, and the lowest environmental impact of current battery technology. Higher capacity batteries (NiMH capacities range from about 1600 to over 2850 mAh, or milliamp hours) are most convenient.

12.54

Another important factor is electrical resistance. Regular alkaline cells have a high resistance, which effectively means they're reluctant to release power rapidly. NiMHs, however, have low resistance, which means they enthusiastically transfer a lot of power in a short period of time. This reduces recharge times when used in a flash unit.

Note that AAs consist of a single electrical unit and thus are technically cells and not batteries. However, I admit "cell" does sound a bit pedantic. ☐ 12.54

12.12.1 Standard AA (zinc carbon / zinc chloride / manganese oxide)

Pros: Generic, cheapest batteries sold, based on chemical designs over a century old. Ubiquitous—readily available at a drugstore or corner shop in an emergency.

Cons: Don't provide much power. Can't be recharged; wasteful. Slow to recharge between shots. Very vulnerable to leaking and corrosion when dead.

12.12.2 Standard AA alkaline (LR6)

Pros: Alkalines are cheaply and readily available anywhere. Store a lot of power and go a reasonably long time between replacements.

Cons: Last much longer than carbon zincs but otherwise have the same disadvantages. Can't be recharged; poor choice environmentally and long-term economically. Slow to recharge: the time ranges from 6–20 seconds, depending on how new the batteries are. Not as effective as NiMHs in high-drain devices.

12.12.3 Rechargeable nickel-cadmium (NiCad/NiCd)

Pros: Relatively inexpensive, rechargeable hundreds of times. Low internal resistance and so can easily decrease a flash recharge time to 4 to 6 seconds.
Cons: NiCad cells contain cadmium: a toxic heavy metal. They must never be thrown into the garbage, and have to be disposed of as hazardous household waste. Limited capacity and thus short run time between charges. NiCad cells can drain dead ("self-discharge") within a few weeks after charging. Some have non-standard casings that don't maintain reliable electrical contact. Can't maintain a full charge if recharged before being fully discharged, a voltage depression phenomenon sometimes called the "memory effect."

12.12.4 Lithium AA (FR6)

Pros: AA cells using lithium chemistry. Store a lot of power, have long shelf lives, and recharge the flash at roughly the same rate as alkalines. Noticeably lighter in weight than other AA types.
Cons: Officially *not* recommended for use with Canon products as of 2014, because of their tendency to become very hot when used heavily. Expensive and not rechargeable (unlike the lithium ion and lithium polymer batteries used in cameras and computers). Steep death curves: will work fine and then suddenly run out of power. Cannot be mixed with other battery types.

12.12.5 Rechargeable nickel metal hydride (NiMH/HR6)

Pros: Affordable and rechargeable hundreds of times. Higher capacity NiMHs (2000–2500 mAH/milliamp hours) approach the runtime of alkalines. Less hazardous to the environment than NiCads. Rapid flash recycle time like NiCads: around 4 to 6 seconds. Not affected by the so-called memory effect.
Cons: Must be charged before first use, because they self-discharge quite rapidly, especially at warmer temperatures. Incompatible with NiCad chargers. Heavier than other AA batteries. Deliver consistent output during use, but drop rapidly when empty.

12.12.6 Hybrid/low self-discharge NiMH

Pros: All the advantages of NiMH, since they're just a refinement of the NiMH design ("hybrid" is a bit of a marketing misnomer in this respect). Arrive from the factory conveniently pre-charged, and their low self-discharge rate also makes them more useful for occasional use. Most are billed as being able to be recharged 1,000 times. Rapid flash recycle time is similar to regular NiMHs.
Cons: Same as regular NiMHs. Slightly lower maximum capacities than regular NiMHs.

Summary? Most experienced photographers stick with hybrid NiMHs. They self-discharge slowly, charge up a flash quickly, can be recharged many

times, and hold a lot of power. Sanyo/Panasonic Eneloop batteries in particular are very popular with pros. I've used them myself for many years and they're sturdy and reliable.

12.12.7 NiMH Chargers

Chargers for NiMH batteries come in three basic varieties.

12.55

Cheap chargers (left) are not computer controlled and simply pump power into the cell. They usually have safety cutoff circuits to prevent overcharging, but tend to shorten battery lifespan because they can't supply power at levels appropriate for the condition of the cell. Not recommended, especially older model chargers designed for NiCad cells, which can damage NiMH cells.

Smart chargers (center) contain computers and charge at different rates depending on the state of the cells (e.g., ramping up a charge versus topping up a charged cell). Unfortunately, the unit shown can only charge cells in pairs, which means that charge rates can't be optimized for each individual cell. However, it's ideal for traveling, since it doesn't require a separate power brick.

Advanced smart charger / conditioners (right) also contain small computers, but the unit shown here can optimize the charge for each cell individually, something most chargers can't do. Each charge rate can be manually adjusted, from slow (better for improved longevity of the cell) to fast (better when in a hurry). Larger models are available that can charge more than four cells at once.

It's definitely worthwhile getting an advanced charger if you do anything more than the occasional round of flash photography. They help you get the most life out of each AA cell, and some units can even drain and condition a cell, which can rejuvenate (to a point) a failing one.

12.12.8 Other battery tips

Batteries can leak corrosive liquid when they're fully discharged. It's wise to remove any cells from a device that won't be used for a length of time.

Some flash units can behave erratically when battery power is low. Weak batteries will produce long recycle times, but can also make the flash trigger randomly or the zoom motor buzz at odd intervals. Similar symptoms occur if the flash unit isn't firmly seated in the hotshoe, or if the battery contacts are dirty or corroded.

Batteries are nothing more than chemical reactions contained in metal cans, and their power is reduced when they become cold. They resume normal performance when warmed up again.

12.13 External battery packs

While portable and convenient, AA batteries are quite small and don't have much capacity. This can be a real problem for working professionals who need to take large numbers of photos in a day. Cycle time also matters, and anything that can reduce the time between flash shots can be very essential for many pros.

12.56

Most of Canon's high-end flash units have sockets on the side for external high-voltage (270 volts) battery packs. All Canon packs use the same proprietary connectors, which fit any Canon high-voltage compatible flash unit. Canon does not sell AC adapters for its flash units. ☐ 12.56

The packs have two basic functions: they speed up the flash's recycle time between shots to a second or two (critical for news or wedding photography) and extend the run time between changing batteries. They can also be useful in cold weather, since the pack can be stuffed inside your jacket to keep the cells warm.

12.13.1 Battery pack types

The largest and oldest Canon pack is the Transistor Pack E, which takes six C batteries with the battery magazine. It can also take the optional NiCad Pack, which has its own special charger. This large bulky pack was the usual power supply for the old Speedlite 480G back in the 80s.

Far more convenient is the Compact Battery Pack E, which takes six regular AA alkaline, NiCad, or NIMH batteries. The Compact Battery Pack CP-E2 can also accept lithium AA cells. Either compact pack can be attached to the camera base using the tripod mount.

12.57

The slightly larger Compact Battery Pack CP-E3 uses eight AA cells. The Compact Battery Pack CP-E4 is similar as well as weatherproof when used with a weather-sealed unit such as the Speedlite 580EX II.

These packs have plastic battery holders called magazines. Additional magazines can be bought and preloaded with sets of batteries, allowing rapid reloads when on a shoot. The TP-E, CP-E, and CP-E2 have different sized

magazines. The CP-E3 and CP-E4 have incompatible magazines because of the latter's weatherproofing. ☐ 12.57

A number of other companies sell high-power battery packs compatible with the Canon high-voltage connector, usually via adapter cables. These include Quantum Instruments' Turbo (lead-acid) and Turbo Z (NiCad), Lumedyne's Cycler, and Dynalite's Jackrabbit. These high capacity packs are fairly large and heavy. They don't use standard batteries and must be recharged each time. ☐ 12.58

12.58 A Canon CP-E4, A Quantum Turbo 2×2, and a Quantum Turbo SC. The Canon pack contains AA cells, whereas the Quantum packs are sealed, rechargeable units with no user-replaceable cells.

While a necessary evil in many circumstances, packs are heavy, bulky, and inconvenient (especially larger third-party products); they also have to tether the flash unit to the pack via a coiled cord. Note that flash units will not work with a high-voltage external pack and can't power its control circuitry.

Some manufacturers also sell low-power battery packs (such as the Quantum Bantam), which can be connected to most AA-powered flash units, even those that lack high-power sockets. They work by replacing the AA batteries with a dummy plastic shell and running a cord to the power pack. Such packs require small notches to be cut out of the battery door to run the wire. (A notched door on a used flash unit is a sign that it was used by a professional photographer, who may not have been very gentle with his or her gear!) These packs aren't high-power and therefore can't speed up the recycle time as dramatically—they're more useful for increasing the number of shots between battery changes.

Keep in mind that portable flash units were not designed for continuous high-power use. It's easy to damage a flash unit if too many high-power bursts are fired in a short period of time, something an external battery pack may make possible. Try not to fire flash bursts for longer than a few seconds, especially at full power manual or small aperture TTL firing. Smoke emerging from a flash unit is universal shorthand for "stop immediately!" Recent models like the 580EX II, 600EX/600EX-RT, and 430EX III/430EX III-RT have limiters or thermometers to reduce the risk of this happening.

12 Studio Flash

Steampunk. *With a sharp twist of his cane, Dr. Lymington-Ffyfe prised open the ancient Gladstone bag whence the mysterious ethereal energy emanated. In utter silence, a brilliant yet insubstantial luminous globe burst forth, to hover unassisted and resplendent above the table, coldly indifferent to the astonishment of the assembled Guild. Light of a purity rarely seen by mortal man pierced the Stygian gloom. "By Jove!" cried the Aviator in unalloyed wonder. "Who could have known that the evil Captain Synge possessed so formidable a source of power?"*

Elinchrom Ranger Quadra inside a foam sphere on a boom over the table, triggered by an EL-Skyport. Matt black gaffer tape was used to conceal any reflections from the light stand and boom. Two Speedlite 580EX IIs inside the bag, firing at manual full power and triggered by one Elinchrom EL-Skyport Universal and one Sonia optical slave. Photographed at the Shunt Lounge and Theatre Company, deep in the dank Victorian tunnels beneath London Bridge railway station. London, England. EOS 5D Mark II, 1/60 sec at *f*/4, ISO 100, 24mm.

KEY POINT
Automated TTL or E-TTL metering cannot be used with most studio flash equipment. Manual metering is the order of the day.

13.1 A flash tube: the heart of any studio flash system.

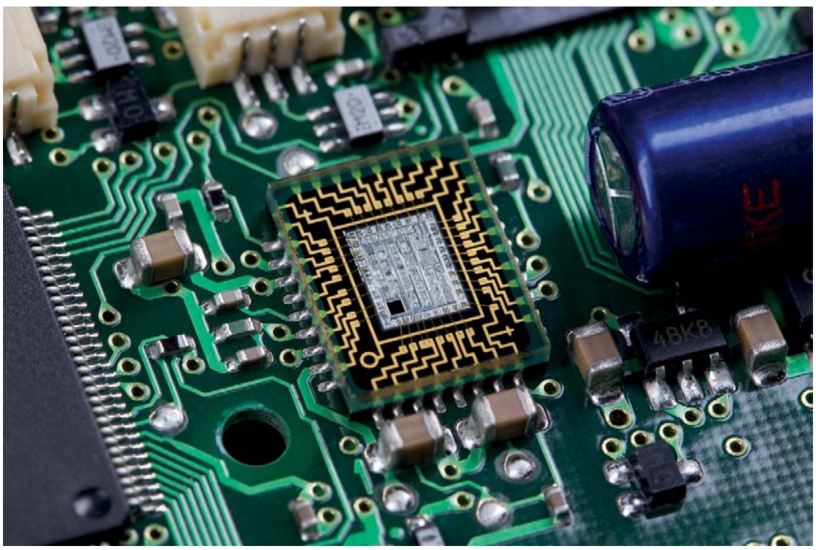
While any kind of flash equipment can, of course, be used in a studio setting, "studio flash" usually refers to large, non-portable flash equipment that's powered by AC current. Large, expensive, and daunting, studio gear has always represented something of a tall barrier between amateur and professional. The jump from battery-powered flash to studio flash has traditionally been fraught with mystery and governed by apprenticeships. Equipment was expensive, difficult to use, and hard to learn.

Aside from the cost, the biggest stumbling block to studio flash has been manual metering. But, as discussed in section 10.2.1, digital cameras have made manual metering much easier to learn and master. With many companies introducing affordable, low-end studio flash units for the advanced amateur market, there's never been an easier time to make the transition to studio lighting. ☐ 13.1

So, why studio lighting? Despite the lack of automatic metering, there are a number of reasons studio flash is widely used by professionals.

- **Power:** Small flash units powered by AA cells don't have anywhere near the light output of the typical studio unit. This matters when photographing larger scenes and when stopping down lens apertures. Big studio gear can light entire automobiles or even larger objects.
- **Speed:** The best studio lighting recharges very rapidly between shots, especially if it isn't being used at full power. By contrast, small lights powered by AAs can take a few seconds to recharge between each take, which is a huge problem for professional shoots.
- **Reliability:** With no batteries to drain, quality studio units can be used day in, day out. Better units are engineered for very accurate power output levels and flash color.
- **Versatility:** The range of light-modifying devices and tools for studio equipment is endless.

This chapter describes common flash-based lighting equipment found in studio settings. Obviously, the specific type of gear will vary depending on the job at hand. A small portrait studio will be arranged differently from a huge space used for photographing cars, or a studio used for photographing commercial packaging or food. But this chapter covers the basics you'll find in most studio setups.



13.2 This Elinchrom Rotalux light modifier looks pretty big, but it's actually mid-sized compared to the monstrous reflectors and softboxes used in professional studios. Shown here without the front diffuser fabric.

13.3 A digital chip and circuit board from the interior of a Speedlite 580EX flash unit. A pair of monolights in studio softboxes was used to provide bright, even illumination.
EOS 5D Mark II, 1/50 sec at *f*/11, ISO 100, 100 mm macro with 20 mm extension tube.

13.1 Types of studio lights

Canon and other camera makers don't make studio gear: the field is the purview of a number of specialized makers such as Bowens, Broncolor, Paul C. Buff (AlienBees/White Lightning), Dyna-lite, Elinca/Elinchrom, Hensel, Interfit, Norman, Novatron, Paterson, Photoflex, Photogenic, Phottix, Profoto, Speedotron... Regardless of the maker, studio flash units are mostly of two types: monolight, and pack and head.

13.4

13.1.1 Monolights

Monolights are self-contained units that include both the flash tube and the bulky power circuitry to drive it. They tend to be long cylinders or boxes, with a tube and reflector mounted on one end and a small control panel on the other end. They plug directly into AC power and are known in the UK as "monoblocs." Most have built-in fans for internal cooling. □ 13.4

Pros:

Monolights come in a wide range of sizes and power outputs. The have their own power supplies, so failure of one unit won't take down an entire setup. They also tend to be affordable, allowing beginners to buy their way gradually into a system, component by component. Monolights from different manufacturers can be used together if necessary, though they may differ in terms of performance, head adapters, subtleties of color output, and so on. □ 13.5

Cons:

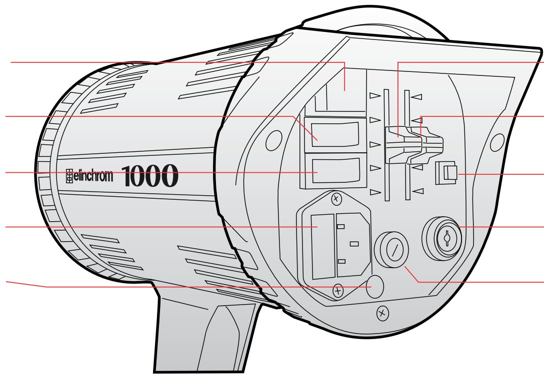
Since the transformers and capacitors are inside the monolight's body, the units can be a little top heavy and might be easily knocked over. In a complex studio setup with multiple flash units, they can be inconvenient since each unit must have its output adjusted manually, one by one (except for advanced models with remote computer interfaces).

13.5 This simple portrait was taken using two low-cost monolights. One was inside a softbox, positioned close to the model, camera right. The other was on the other side of the room. It had no modifiers and was set to provide subtle outlining to the model's left shoulder and hair.

Analog monolight controls

Traditional monolights contain analog electronics to control the power output, using a dial or a slider like a household dimmer switch. The back-panel controls on a monolight vary, but typically look something like this classic Elinchrom studio unit. ☐ 13.6

13.6



Power input socket. Usually a standard female IEC connector so the cable can be detached for travel and storage.

Power switch. The power rating may be listed here. Most studio units are localized to the region of sale (e.g., 110 VAC for North America, 100 VAC for Japan, and 240 VAC for most of the rest of the world), though modern units often have universal power supplies.

Modeling light switch. Enable or disable the tungsten modeling lamp.

Test fire button. This may illuminate to indicate that the unit is fully charged and ready to go.

Fuse. Some units contain a circuit breaker.

Modeling light output slider. The brightness of the tungsten modeling light.

Power output slider. The output of the flash tube itself.

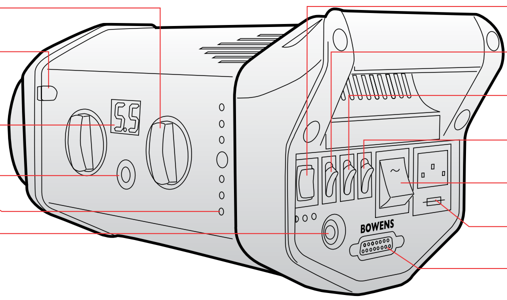
Optical slave sensor. This unit has a combined sensor for the optical slave and a push button switch to enable or disable the slave. Some units have white half-dome covers over the light sensors.

Sync input. A socket for an external sync cable. This model has an unusual manufacturer-proprietary plug, but other makers use 3.5 mm audio plugs and the like.

Digital monolight controls

Newer monolights contain digital electronics. This doesn't necessarily mean they can interface with a personal computer or have output levels controlled automatically, though some do. Instead, it means a specific numeric value can be punched in, making output levels easily repeatable. Some digital monolights use up/down pushbuttons, and others use dials or sliders resembling analog units. Others include interfaces to personal computers or smartphones. Either way, there's usually a small panel showing the current output setting in stops, fractions of full power, or an arbitrary numbered scale. It won't display the power output in an absolute form, so you're rarely able to compare the output of different units.

Figure 13.7 shows the key controls of a modern digital unit from Bowens:



13.7

Power input socket. The usual IEC connector.

Power switch. This unit has a three-position switch: off, on using AC power, and on using battery power.

Modeling light switch. For the tungsten modeling lamp.

Flash ready. This controls the way the the modeling lamp indicates that the flash tube is ready to fire.

Audible beeper switch. An audible signal for flash ready.

Slave sensor ("cell") switch. Turns on the slave sensor.

Sync input. A 1/4" plug for sync input.

Proprietary battery input. A proprietary jack for power from an external battery pack.

Power setting dials. This unit has an unusual system. The left hand dial controls the power level in stops. The right-hand dial controls the level in tenths of a stop.

Power setting display LED. The power setting in stops.

Test fire button. The green light indicates the unit is ready to fire.

Status lights. Various LEDs show the status of different functions.

Speedring release button. Used to unlock the unit's accessory attachment ring (see 13.2.1)

13.1.2 Pack and head lights

The alternative to monolights are pack and head lights, where a single hefty power pack is linked by cables to multiple flash heads. The packs, sometimes called generators in the UK, vary in size and capacity, but are uniformly fairly expensive. They can be symmetrical units that supply equal amounts of power to each head, or assymetrical units that give preferential amounts of power to one head or another. ☐ 13.8

Pack and head lights are the workhorses of many professional studios, though monolights are often used as supplementary lighting. Recent digital pack and head units have USB and Wi-Fi interfaces and can be controlled remotely using a computer or smartphone. These products have on-screen interfaces for configuring complex lighting setups, which can be saved to disk and restored later. Of course, the physical equipment has to be moved and positioned on the set by hand, but at least power settings are easily set.

13.8 A traditional pack and head combination commonly seen in professional studio environments.

13.9 This head has an interesting feature: the flash tube can be moved in or out by turning a dial providing a zoom effect like that of a Speedlite.

13.10 Compact and rugged, Swedish-built Profoto units are popular with pro rental companies.

Pros:
A single pack can power multiple heads, so it's simple to quickly adjust the output of each head without a lot of walking around. The heavy and bulky transformers and capacitors all sit on the floor, which keeps the heads relatively lightweight and small. ☐ 13.10

Cons:
The systems are quite costly. Cables to the heads can be fairly heavy and usually involve proprietary connectors, making it expensive to have long cable runs (a 15-foot cable for one proprietary system might cost as much as an entire entry-level monolight). Failure of a pack will take down the whole system. One generally can't mix and match heads and packs made by different manufacturers. ☐ 13.11

13.11

13.1.3 Ringflash

Ringflash units are specialized heads that employ large ring-shaped flash tubes. Like smaller macro rings, studio ringlights fit around the end of a lens, but pump out a lot more power than battery devices. The result is flat and even lighting with essentially no shadows on the foreground subject. However, if the subject is close to a wall, there will be a characteristic "dark halo" shadow.

Studio ringlights are a popular tool for fashion photography because of the punchy look they produce. Used more subtly, they can also provide shadowless fill.

Studio ringflashes are usually pack and head because a full power source built around the tube itself would be heavy. Ring attachments often have optional reflectors or diffusers on the front to control the quality of the light, and they usually include a bracket assembly to which a camera can be attached by its tripod mount socket. ☐ 13.12 and 13.13

13.12

13.13 The dark halo betrays the light source: a ring flash.

13.1.4 Battery packs

Professional location work, outdoors or in remote settings, often calls for portable high-power solutions. Consequently, many makers sell portable packs containing large rechargeable batteries. In the past, lead-acid gel batteries like those used in electric wheelchairs were common, but lithium packs are now popular. The packs mostly follow a pack and head model,

and some can be recharged using a car adapter. A recent innovation is the portable monolight with integral battery pack.

These specialized professional tools are great for documentary and fashion photography, as they give you full studio power basically anywhere without the inconvenience, noise, and expense of gas-powered generators. Of course, generators are still used for lavish expedition-type photo shoots, where there's a budget for a dozen assistants and an air-conditioned trailer for the talent, but battery packs are suitable for more modest shoots.

13.14 Elinchrom Ranger Quadra, Bowens Explorer 1500, and Bowens Travelpak battery packs.

The packs range in size. The Elinchrom Ranger Quadra, for example, is extremely light and portable as this type of equipment goes. At seven pounds, it wouldn't be fun to wear on one's shoulder for extended periods, but it is doable. It uses tiny flash heads that can be adapted to standard Elinchrom accessories if necessary. In the photograph that opens this chapter, the small size of the Quadra flash head was ideal for concealing inside a hollow Styrofoam ball to create a mysterious hovering sphere of energy.

In contrast, the Bowens Travelpak is the size of a small car battery and isn't wearable, but it can power a pair of full-sized Bowens Gemini monolights that support any traditional Bowens S-type accessory rings. Two capacities of interchangeable, rechargeable batteries are available. Additionally, the Bowens Explorer 1500 can deliver 1500 watt-seconds of power, but it's more like a large car battery. □ 13.14

13.15 This photo was taken in a condemned warehouse with no AC power. It was lit mostly by a Bowens Gemini R flash unit powered by a Travel-pak battery. An on-camera flash unit served as an optical trigger and added a subtle catchlight to the model's eyes.

13.1.5 Inexpensive gear

Professional studio equipment can be very expensive; prohibitively so for a beginner. Even renting the gear adds up quickly, so the rock-bottom lights sold on Internet auction sites are very attractive. The question is, are they worth it?

Well, like anything, it depends on your priorities. The drawbacks of cheap gear are obvious. The products tend to be low-powered, have long recycle times, produce inconsistent light output or color, are less rugged than name-brand gear, have non-replaceable tubes with short lifespans, may be difficult or prohibitively expensive to repair if they go wrong, and, finally, have the unknown factor that they may not have had proper safety approvals.

Some products are fairly useless, such as these screw-in flash units. These are the size and shape of regular light bulbs, housing instead a tiny flash unit and an optical slave trigger. They might be useful on location for adding a bit more light from existing light fixtures (just replace the bulb with the flash), especially if flash color temperature is needed. But they're weak, slow, and aren't adjustable in any way. □ 13.16

On the plus side, rock-bottom gear is cheap! And since any collection of monolights can be mixed and matched as long as precise color temperature

13.16 Low-output screw-in flash unit.

13.17

13.18

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13.20

isn't a concern, cheap lights can be a good way for a casual amateur or a student on a tight budget to get started.

The key is not to start too low-powered for most applications. A flash unit billed at, say, 150 watt/seconds (see 7.16.1) is very low powered. There's no point in getting something so weak it can't be used for portraiture in a medium-sized room, so don't buy a unit advertised as under 200 or 300 w/s. Note that these units are often sold in kits with a load of cheap accessories and they're listed by their combined light output. For example, 450 w/s might sound great, but not if it's a box set containing three lousy 150 w/s units. □ 13.18

Having said this, it's also impossible to compare the power output of flash devices across various manufacturers. Many studio units are marketed on the amount of power they consume (watt/seconds), not the amount of light they pump out. Others refer to light output, but there are many ways to measure that: does that include the effect of light modifiers? Sometimes the only way to make an adequate comparison is to do a test yourself.

It's also worth thinking about future growth. Does it make sense to invest in something of disposable quality? Or does it make more sense to invest in a product with higher build quality and more growth potential? After all, quality gear tends to hold its value in the used market fairly well.

Some brand-name manufacturers also sell introductory gear at lower prices, such as this Elinchrom D-Lite unit (see figure 13.18). This equipment isn't up to the build or power standards of their professional equipment, but it's largely compatible with the rest of their product line.

Another recent change is the development of Chinese manufacturers: Until the past decade, most high-end studio equipment was made in Europe or North America, with Asian makers relegated to producing low-end gear. But now it's not that simple. For example, this is a Phottix Indra head, which comes with a matching portable battery pack. It's notable for high output (advertised as 500 w/s) and advanced electronics that support TTL flash metering over a radio connection. □ 13.19

13.2 Basic flash unit features

These days most studio units have a fairly standardized shopping list of features.

13.2.1 Flash heads and speedrings

The head is the business end of the flash unit. The most common flash tube design is an omega loop, or near-circle. The tube may be tinted a very pale yellow color to slightly warm its light. Positioned at the center of the tube is an incandescent light bulb or LED lamp, used for modeling as described in the next section. □ 13.20

The tube and bulb are mounted in front of a metal reflector. The end of the head usually has a circular mount known as a “speedring,” to which various light-modifying attachments can be fastened. Speedrings are manufacturer-specific and conform to no particular universal standard, though sometimes a smaller maker will adopt the speedring system used by a major manufacturer. ☐ 13.21

13.21 Elinchrom (left) and Bowens (right) speedrings.

13.22 This studio unit is equipped with a heat-resistant Pyrex glass dome.

Optionally, the tube and bulb can be covered by a heavy glass dome, mainly to protect the delicate lamps but also to minimize the risk of injury. Some Pyrex domes have a clear UV-block coating for improved color accuracy, since ultraviolet energy shows up blue on film and sensors. ☐ 13.22

13.23

13.2.2 Modeling lights

Studio lights traditionally have tungsten or tungsten halogen bulbs—or, increasingly, white LEDs—with the flash tube. These continuous lights are used to preview the effect of the light on the scene. They make it easier for you to predict how multiple-light setups will work and to see where shadows are cast. Another useful function is to light the room during setup: handy for avoiding the problem of models with gigantic pupils from sitting in the dark. ☐ 13.23

Some flash units shut off the modeling lights when firing the flash (to prevent them from contributing light to the scene) and others don’t. Better units have proportional modeling lights, where the brightness of the tungsten lamp matches the relative brightness of the flash output setting for a more accurate preview.

The primary issue with tungsten modeling lights is their heat output. Some smaller enclosed light modifiers, such as softboxes, can cause a flash unit with a modeling light to overheat. In such cases, it’s best to use the lights only sparingly. There’s also serious fire risk from high-wattage bulbs (section 7.22.1). This is an area where the low heat of LEDs is very advantageous. LEDs, such as the ones used as modeling lights by this Elinchrom Quadra unit, can also serve as a continuous light source for video. ☐ 13.24

13.24

Incandescents are a problem for battery units due to their heavy current draw. Some battery systems omit modeling lights, whereas others, such as this Profoto pack, put them on brief countdown timers. ☐ 13.25

13.25

13.26 The hemispherical white dome covers the light sensor used by an optical slave.

13.2.3 Optical slaves

As discussed in the off-camera flash section, it's very common for studio flash units to contain simple optical slave sensors or "photocells," which trigger the flash unit in response to a pulse of light from another flash unit or from an infrared trigger (section 11.7). This is a low-cost yet effective way of synchronizing multiple units with the camera.

Since optical slave sensors can be a liability in public settings, where someone else's camera flash can set off a slave inadvertently, so they can usually be turned off (switches are often marked "CELL"). Sensors are typically positioned on the back panel of a monolight, which is sometimes a bit inconvenient, as the sensor may not always face the triggering flash unit. ☐ 13.26

Another issue is that optical slaves can be set off prematurely by automated flash units with prefire, such as that used by E-TTL. Some digital monolights have the ability to ignore preflashes and only trigger when the final flash goes off.

13.2.4 Trigger voltage

The issue of high trigger voltages has been discussed earlier (section 10.5), but it's worth bringing it up again. Many older units use high trigger voltages that can damage a camera. Always confirm that the camera can withstand high trigger voltages before using a direct cable. Alternatively, it's usually safer and more convenient to use optical or radio triggering instead.

13.2.5 Duration versus output

Speedlite-type, battery-powered flash units vary the light output by varying the *duration* of the pulse. The longer the pulse, the more light hits the film or sensor. Conversely, for lower power outputs, the flash duration is shortened.

Most studio flash units, however, maintain more or less constant flash durations but alter the *amount of power* being delivered to the flash tube. In other words, a studio unit usually "dumps" its entire capacitor charge in one go. If a partial output is set, the unit simply doesn't charge up its capacitor fully before dumping.

The pulse lengths also tend to be longer than those on small hotshoe units, making the majority of studio flash units less effective at freezing motion. One exception is when studio flash units are billed specifically as being high-speed capable, which often use the duration-altering technique.

13.27 This flash unit has a confirmation beeper marked, somewhat incongruously, by a musical note icon.

13.2.6 Audio confirmation (beepers)

Many flash units contain small beepers or "sounders" that emit a tone when a flash is fired, making it easier to know if a given unit is working or not. Some have different tones or numbers of beeps, so it's possible to tell if a flash in a specific group has fired. ☐ 13.27

13.3 General studio gear

The well-equipped photographic studio is overflowing with all kinds of specialized tools and equipment. Some common items are described here.

13.3.1 Light stands

Since most scenes don't call for flash units resting on the floor, light stands are an essential part of any studio setup. They're similar to tripods in that most have three-legged bases, but they differ in that most of the vertical height is a single tube (i.e., the legs join the vertical tube lower down, rather than higher up, as is the case with tripods). This is because rock-steady stability is less of an issue with light stands than with tripods. As long as the stand is fairly sturdy, it doesn't matter if it wobbles a bit when bumped, which would be unacceptable for a camera tripod. ☐ 13.28

Most light stands are made of aluminum tubing, painted black to minimize unwanted reflections. They generally have telescoping segments and foldout legs at the base. A particularly sturdy design with rotating legs is known as a "C-stand," or "Century stand," and is common on movie sets.

Better quality studio light stands have internal baffles or air pistons known as air cushioning, which slows the speed at which the collapsing tubes descend. These can prevent delicate flash equipment from being severely jolted if a clamp on a light stand's tube is released unexpectedly. It's worth investing in solid light stands rather than going for lightweight versions. Very inexpensive stands are not stable enough, which puts heavier studio gear at risk of toppling.

Unlike tripods, light stands generally aren't designed to stand flat on uneven ground. A few stands have a "lazy leg," which is a leg of adjustable length to compensate for uneven surfaces.

13.28

13.3.2 Booms

Booms are cantilevered or counterbalanced extension arms fastened to heavier duty light stands. They're useful for holding lights above a subject's head as a hair light, for example, or for positioning small light heads or monolights in tight quarters. Booms often have clips on the end for attaching sandbag weights so that they don't topple over. ☐ 13.29

13.29

13.3.3 Light stand attachments

Most light stands have turned brass fittings on the top known as "spigots" or "male studs" (yes, really). These are just turned brass rods, 5/8″ in diameter, to which most studio flash units attach. They aren't threaded, and rely mainly on gravity to hold the unit in place. The flash unit will also have a locking handle or bolt to prevent accidental dislodging.

13.30 The chrome spigot or stud of a light stand.

Some light stands may have 1/4″ or 3/8″ tripod-style threaded bolts for attaching smaller battery-operated Speedlite flash units and other accessories. ☐ 13.30

13.3.4 Ceiling support systems

While light stands are ubiquitous in any studio, they can obviously get in the way, particularly in smaller spaces. For this reason, many full-time studios use ceiling-mounted tracks to hang lighting equipment. The tracks may have pantographs or scissor mechanisms so that the flash units can be moved easily from one vertical position to another.

13.3.5 Backdrops

Portraits and product shots often benefit from simple, uncluttered backgrounds. While bare walls can be used, it's often easier to hang a backdrop behind the subject.

Canvas, muslin, and vinyl

Fabric, sometimes painted or patterned, has been used for studio backdrops since Victorian times. In those days, portraits were usually taken in front of heavy canvas sheets, frequently painted like the stage flats used in theatres. In keeping with the style of the age, these paintings often had neoclassical themes, such as columns and Grecian urns. Today it's more common to see blotchy, abstract patterns that produce broad washes of color when thrown out of focus by narrow depth of field. But if you want something tackier, like phony-looking clouds or unconvincing forest paths, a quick check of auction sites reveals some pretty remarkable excursions to the Land of Cheese.

The main issue with fabric is that it must be carefully rolled for storage to avoid unsightly creases. Thinner muslin can be steamed and ironed. Alternatively, fabric can be deliberately crumpled so that it yields random patterns when kept out of focus. Vinyl is a popular material as well, since it can easily be printed on using large computer printers, is easy to clean with a wet sponge, and doesn't crease easily.

Seamless paper

Though painted fabric has its place, creases are difficult to avoid. For that reason, wide rolls of paper are commonly used for studio backdrops. These large rolls of seamless paper, white or black or a solid color, are rolled out from a support crossbar. They hang straight down, meeting the floor in a smooth sweep or scoop that eliminates an ugly seam. Once the paper gets dirtied, it can be torn off and a clean piece unrolled. ☐ 13.31

Seamless paper must be stored carefully—either vertically or else on a proper rack. If it's stored horizontally in a box, it can develop flat sections on the bottom of the roll, which results in creases.

13.31 A roll of seamless white paper on a backdrop stand.

Backdrop supports

Stands, racks, and poles are commonly used to support backdrop materials. Stands usually consist of a pair of light stands with a horizontal crossbar and are ideal for portable setups.

Other solutions include permanent wall racks with hand-operated or motorized chain drives to allow the material to be easily adjusted. Vertical poles extend from floor to ceiling, typically with adjustable spring mechanisms to press firmly upwards. Clamps and crossbars are then attached to the poles to hold the rolls of paper or fabric.

13.3.6 Radio control

Some flash units contain built-in radio receivers, simplifying their use in a multiple-flash radio setup (section 11.9). They may be radio systems proprietary to the maker of the unit, such as the Elinchrom Skyport or Bowens Pulsar, or they may rely on a third-party radio system such as PocketWizard. Some may support both. Bowens lights, for example, support interchangeable plug-in receivers the size of a matchbook. Receivers compatible with both Bowens Pulsar and PocketWizard are available. □ 13.32

13.32

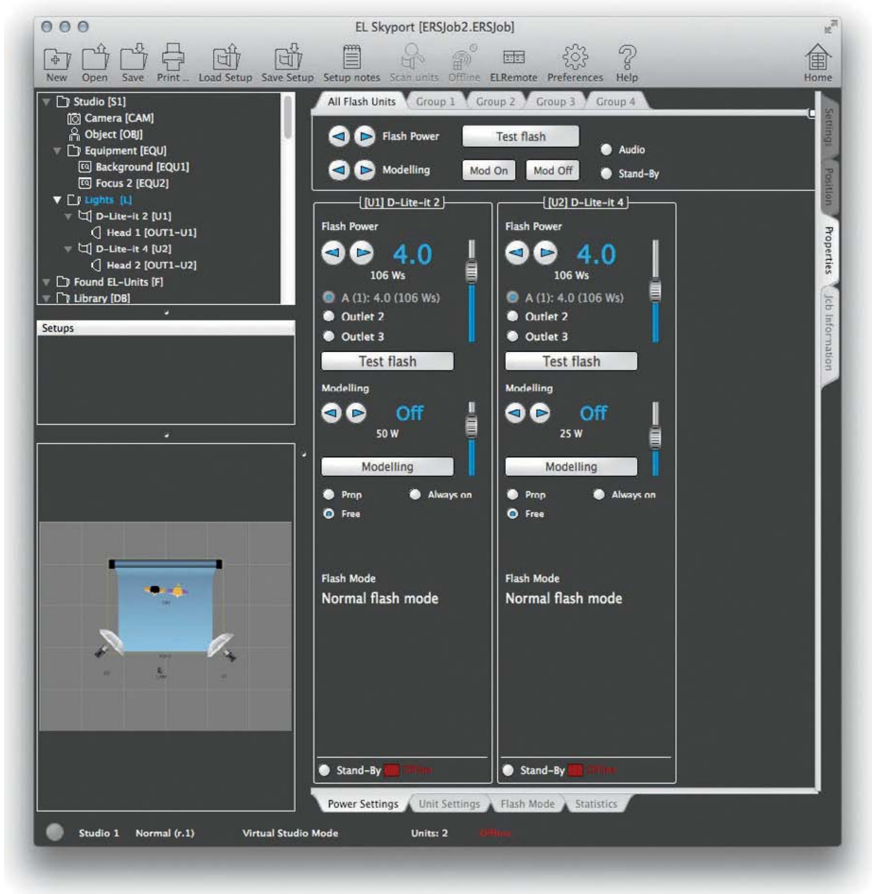
Such integrated receivers are very handy since they don't need separate batteries and can't get lost. Of course, they're only useful when used with a compatible transmitter. Most radio systems are sync-only, though some companies such as Elinchrom and White Lightning have systems that can specify output power levels.

13.3.7 USB/Infrared/Wi-Fi control

The more advanced digital units may have built-in remote control, accessed via USB cables, infrared signals, or computer Wi-Fi networks. These permit the unit to be controlled or adjusted by a remote device or a computer. For example, custom software running on a laptop can let you adjust and save preset output configurations for a group of flash heads. Graphic tablets and phones can also be used to control studio lighting.

In addition to actually controlling the remote flash units, Elinchrom's EL Skyport software, shown here, can also store equipment inventory and lighting diagrams. You can sketch out the lighting arrangement and then trigger the flash units from the computer.

13.33



13.4 Studio light modifiers

In this section we could go on forever. There are countless types of light modifiers for studio gear, though the most common fall into the categories listed here.

13.34 A studio portrait setup. The primary light source is a beauty light with a diffusing fabric “sock” located on a light stand at camera right. The background is a self-illuminating Lastolite HiLite box. To the front is a Lastolite Trilite/Triflector reflector panel, a three-lobed arrangement that bounces light upwards.

13.35

13.36

13.4.1 Flash head reflectors

These are metal dishes or open cylinders that fit around the flash tube and direct light outward. A flash unit fired without a reflector sprays light in a complete hemisphere, a situation known as “bare bulb” flash. A reflector guides the light forward, narrowing its angle of coverage and improving its efficiency.

Flash head reflectors are usually described in terms of the number of degrees of coverage that they offer, and are sometimes called “spill kill” reflectors since they keep light from spilling out everywhere. ☐ 13.35

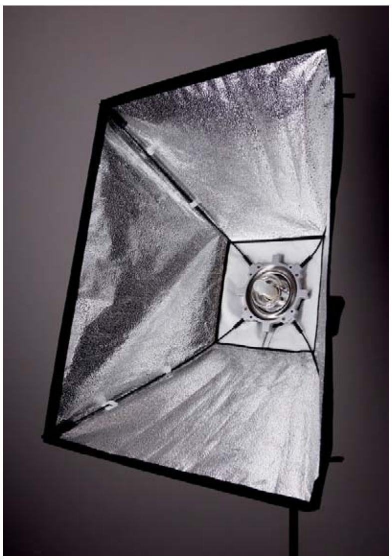
One special type of reflector is the background reflector. This unusual shape directs light from a floor-located flash unit up towards a backdrop, creating an oval-shaped pool of light. These reflectors usually have metal clips for attaching colored plastic gel sheets. ☐ 13.36

13.4.2 Umbrellas

The unassuming umbrella is one of the oldest photographic light modifying devices. Like an ordinary rain umbrella, it’s a curved round fabric surface supported by metal struts. When not needed, it can be collapsed and put away. Umbrellas are popular because they’re convenient and portable, making them ideal travel solutions. In fact, collapsible umbrellas with telescoping shafts and folding struts can fold up into very small tubes.

13.37

13.38



13.39 A typical softbox, with its front diffuser fabric removed to reveal the stippled interior, speedring, and metal support rods.

Umbrellas come in two basic types: reflective and shoot-through. Regardless of which umbrella type is used, umbrellas have a signature scalloped circle catchlight in the eye. Often the umbrella struts themselves can be seen, though some have fabric-covered struts to reduce this effect. Most studio flash units have spring-loaded holes to accommodate umbrella shafts, which typically have diameters of around 8–9 mm. Elinchrom units have an unusually narrow hole diameter of 7 mm that isn't compatible with all umbrellas.

While umbrellas are affordable, lightweight, and portable, it's difficult to control the light they produce, particularly shoot-throughs, which tend to send out light in every direction. They're great for quick grab-and-go shooters like journalists with limited setup time, for hobbyists on a tight budget, or for relatively uncritical commercial applications such as school photos.

Reflective umbrellas

Reflective umbrellas have interiors lined with white, silver, or gold fabric, and are designed to serve as a large area from which light can be bounced. In this configuration, the flash unit sits between the subject and the umbrella, pointing *away* from it. Reflective umbrellas are relatively light efficient, since they are reflectors and not diffusers. They're often backed with black fabric to reduce the amount of backspill caused by light passing through the umbrella's fabric. ☐ 13.37

However, they do have a couple of disadvantages. First, because all the light-producing gear sits between the subject and the umbrella, it's not possible to get the umbrella very close. The farther the light-emitting surface is from the subject, the harder it is to light the subject. Second, though they increase the light area, they don't diffuse or soften it that much.

Shoot-through umbrellas

Shoot-throughs are umbrellas used as diffusers rather than reflectors, made of translucent fabric with no backing material. They are, in effect, foldout diffuser panels. Shoot-through umbrellas can be very soft light sources, since it's easy to position them extremely close to the subject—the flash unit sits on the opposite side of the fabric from the subject, giving more clearance. However, they do consume a lot of light, reducing the overall flash range. Their output is less even than softboxes, as they tend to produce brighter areas (hotspots) at the center. Despite these drawbacks, they're cheap, portable, and commonly used. ☐ 13.38

13.4.3 Softboxes

Softboxes are so called for two reasons. First, they're capable of producing extremely soft "wraparound" light, making them ideal for portraiture. Second, they're constructed from fabric held together with thin rigid metal rods, like a tent. They are essentially pyramid-shaped constructions. Heavy, black synthetic material prevents light from leaking out the back and sides.

The large, flat, face of the box is fronted by at least one, but usually two, layers of translucent white cloth to diffuse and soften the outgoing light. The interior of the softbox is lined with white or stippled metallic silver fabric. The back of the softbox usually has a speedring compatible with the studio flash unit it's designed for. The light from the flash tube radiates out into the box, bounces around, and leaves via the front diffuser panel. These enclosed fabric boxes can overheat to dangerous levels when used with incandescent modeling lights. ☐ 13.39

Softboxes are collapsible and fairly portable, though most can be time-consuming and inconvenient to reassemble because of the tight-fitting metal support struts. Photojournalists and others who do on-location portraiture use collapsible sprung softboxes, which are considerably easier to open and repack.

Many softboxes have a black fabric lip that extends around the edge, thus blocking some stray light from escaping the sides. Some also have Velcro fasteners that permit the attachment of fabric grids. Fabric grids, similar to the small hard plastic grids for battery units discussed in section 12.6, can direct light outwards with relatively little spill on the sides.

Most softboxes are rectangular, but some have square or octagonal front faces. The shape governs the coverage area of the light as well as the shape of the catchlight in the eye. For example, 3/4 portraits are often best served by rectangular softboxes rather than square ones.

13.40 This portrait was lit with a single softbox, camera right, as the catchlights in the light bulb and wine bottle reveal.

13.4.4 Striplights

Striplights are essentially very narrow rectangular softboxes. They are used as sidelighting in portraiture in order to give a glowing outline to a subject. They are also commonly used in product photography to emphasize the shape of objects, such as bottles. Striplights were used extensively for the product photography in this book, providing an outlined look for the black plastic devices. ☐ 13.41 and 13.42

13.41

13.42 This shot was lit by two striplights, one on each side of the model.

13.4.5 Beauty dishes and deflectors

Beauty dishes are shallow, dish-shaped pans. They attach to a flash unit's speedring and are typically bare, silver-colored metal or painted white. The opening for the flash tube is capped by a small deflector plate that reflects the light back into the dish and out toward the subject. This type of deflector is usually silver or white, but can be gold, as shown here, for warmer light. ☐ 13.42

Beauty dishes offer very direct lighting and are frequently used for portraits of youthful people with smooth, flawless skin. They don't always provide the most flattering illumination for other people, though the addition of a fabric diffuser can soften the light slightly. The dishes are often used as an overhead light on a boom. ☐ 13.43 and 13.44

13.43

13.44

A related accessory is the deflector without the dish. This attaches to the umbrella mount via a rod and prevents direct light from the flash tube hitting the subject. It would normally be used with a regular softbox or similar modifier, transforming it into a beauty dish, but it's shown here without a modifier for demonstration purposes. These deflectors provide some of the advantages of a beauty dish without the inconvenience of a non-collapsible metal dish. ▢ 13.45

13.45

13.4.6 Self-illuminated panels

Large, self-supporting fabric panels are available for backdrop purposes. They light up pure white when the head of a flash unit is inserted into a hole in the side. They're ideal for taking high key portraits (section 14.2.1) and 3/4 body shots, since the self-illuminated design prevents the appearance of shadows behind the subject. This makes them great for small spaces, such as passport photo applications, since the subject can stand quite close to the panel without shadowing. The panels can also serve as huge softboxes.

They aren't so useful for full-body portraits where the subject's feet are visible, since there will always be a visible join between the self-illuminated backdrop and the non-glowing floor. Like softboxes, the panels should not be used with an incandescent modeling light because of a serious risk of fire.

13.46

Most of the product photos in this book were taken using the Lastolite HiLite panel shown here. This provided a pure white background in a small studio with a minimum of post-production cleanup. ☐ 13.46

13.47

13.4.7 Reflecting panels

Simple reflecting panels are bits of fabric stretched over a frame. They come in all shapes and sizes, and mainly serve one function: they bounce light back to fill in shadowed areas. Some, like the Sunbounce described in section 12.5.8, use frames that are slotted together. Others employ sprung metal frames, so they can be stored in a package the size of a plate, yet pop open in moments. ☐ 13.48

Reflecting fabric may be silver, gold, or alternating gold and silver stripes for cooling or warming the light. Gold panels are often too warm for general use, so the "zebra" stripes are a useful middle ground. Panels may also be black (sometimes jokingly called "negative reflectors") to absorb light where necessary, creating more shadowed areas. ☐ 13.49

An unusual product is the Westcott Eyelighter, which is a curved reflector that's positioned in front of, and below, a model. It's similar to the triflector shown in 3.4, but results in a seamless curved highlight in the subject's eyes. ☐ 13.47

13.48

13.49

13.4.8 Snoots

Snoots are simple metal tubes, often with stepped sides, used to transform the light into a beam for hard lighting effects. They concentrate light in a spotlight-like fashion, though not as sharply and at considerably less expense than an actual spotlight with a lens. □ 13.50

13.50

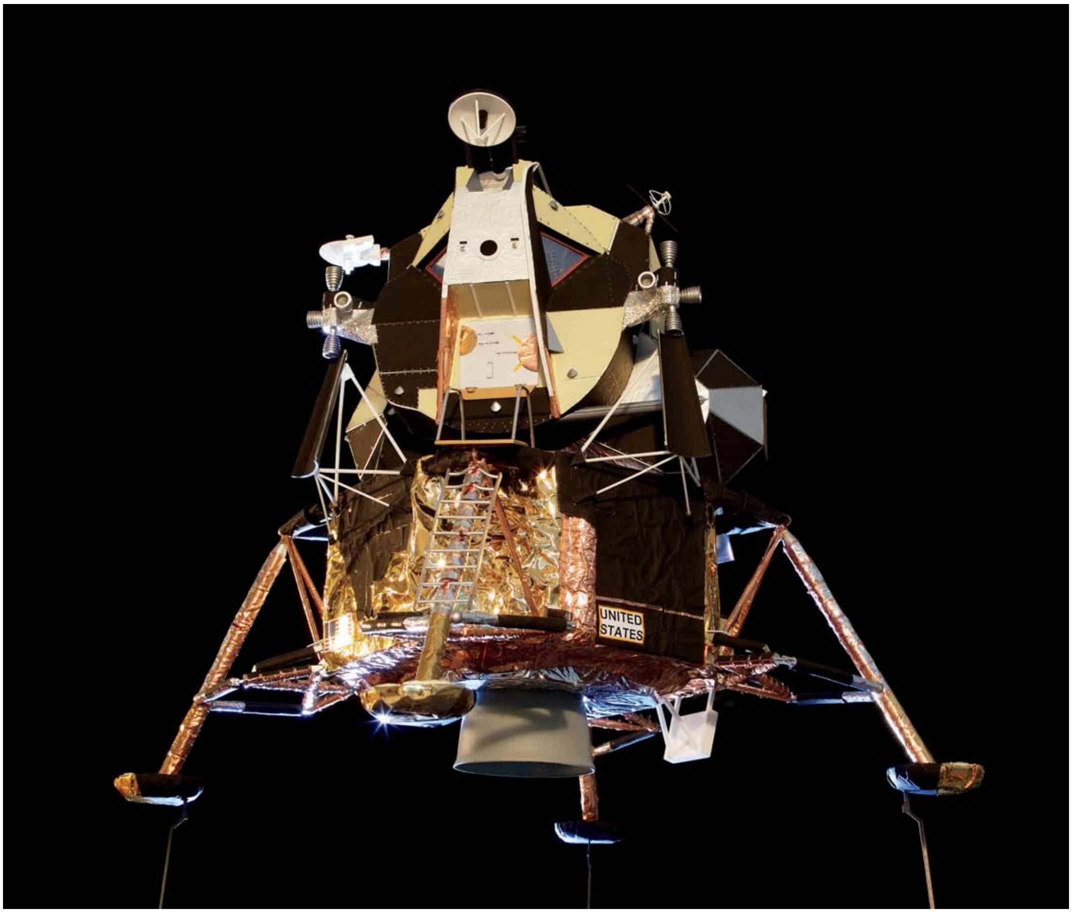
13.5 Hot lights

After talking about flash all the way through this book, what about hot lights? It seems obvious that regular incandescent or fluorescent lighting should make perfectly good light sources for photography.

It's true that hot lights can be used for most forms of photography. Prior to the invention and widespread use of flash equipment, most studio portraits were done with continuous forms of electric light. Hollywood glamour photos of the 1940s, for example, were shot on huge 8″ × 10″ glass plate negatives, with models lit by the same massive Fresnel lens spotlights that were used for movies of the age.

Most beginning photographers start out using regular home improvement warehouse halogen lamps on telescoping stands. That is, of course, a perfectly reasonable way to go on a tight budget. Another option is blue-coated "photoflood" light bulbs—high-output tungsten bulbs that are deliberately overdriven to produce a whiter light at the cost of a shorter lifespan. □ 13.51

Continuous lighting is considerably cheaper even than inexpensive flash equipment. However, flash offers a number of advantages in key areas of photography.



13.51 This scale model of the Apollo 11 lunar lander was lit using a pair of tungsten photoflood bulbs in reflectors. Note, however, that the bottom of the model is backlit with a subtle bluish light. This was actually a flash, with its higher color temperature, fired manually beneath the model during the exposure. No filtration was put on the flash head in order to highlight the color difference.

13.5.1 Heat

Hot lights are, well, hot. A studio full of thousands of watts of continuous tungsten lights can get extremely toasty. This can cause models to sweat, flowers to wilt, and fire risks to increase. Flash units generate heat mainly from their modeling lights; they generate very little warmth when they fire, simply because the light duration is so short.

Fluorescent tubes are one way to avoid the heat issue—though not all fluorescent lamps are suitable for color photography, since many don't output particularly pure white light. Even fluorescent tubes billed as "full spectrum" can produce slightly greenish light, requiring pale magenta filters to correct.

13.5.2 Power consumption

Tungsten light consumes a lot of electricity. It isn't environmentally friendly, is quite expensive in the long term, and requires reliable power with adequate circuits to handle the load. A studio with permanent continuous light may need to have its wiring upgraded for safety.

13.5.3 Fewer light modification options

The heat generated by incandescent bulbs limits the types of light modifiers that can safely be used. Softboxes for constant lights do exist, but they must be much more rugged and heat resistant than ordinary flash-safe softboxes. Plastic gel filters on hot lights must be used with care, as they can melt or catch fire.

13.5.4 No freezing of motion

Because flash durations are short, they can be used to effectively freeze motion. At an extreme, they can be used for dramatic motion-freezing shots. The brief exposure duration is useful for ordinary portraits as well. A shot taken with flash is often sharper and crisper than a portrait taken with continuous light.

It takes a surprising amount of continuous light to illuminate a scene, so exposure durations can be quite long when not using flash. This increases the risk of motion blur, particularly if the subject is moving or the camera isn't on a tripod.

13.5.5 Limited filtration requirements

Flash produces light of the same approximate color temperature as daylight. In contrast, tungsten light always has a much lower color temperature and is thus a fairly orange light. When using daylight-balanced film this means that blue filters are needed to match colors. You *can* buy tungsten-balanced film, but it's hard to find: most film is daylight-balanced.

This isn't such an issue with digital photography, since DSLRs can be adjusted to any white balance setting you want; but mixing and matching light sources of different color temperatures can be a problem.

13.5.6 Inconsistent color temperature

A flash tube fired repeatedly at precisely the same power output will produce light of the same color temperature over and over. Tungsten lights, however, start to age the moment they're turned on. As the filaments burn and age, the tube interiors slowly blacken, resulting in a gradual yellowing of the light. In fact many photographers throw out photoflood bulbs the moment the color output starts to shift, which is long before the bulbs actually burn out. Flash photography is a better way to assure consistent color, which is critical for commercial applications.

13.52 This photograph of the Clockwork Quartet was deliberately lit with continuous tungsten lighting to convey a feeling of Victorian gaslight. The drawback is that the long exposure has caused some band members to blur slightly over the long exposure.

13.53 An affordable hobbyist-oriented monolight.

13.5.7 Easily adjustable power output

It's easy to adjust the power output from a flash tube by adjusting its power usage or pulse duration. However, tungsten lights radically drop in color temperature when dimmed, becoming quite orange. Fluorescent tubes are difficult to dim, and many can't be dimmed at all.

13.6 Cheap vs. expensive

Newcomers to photography are often flabbergasted at both the high cost of studio gear and the range of pricing. A pair of monolights, seemingly identical in terms of specifications, might be tremendously different in price. Why are some products so costly?

In photography, as in many things, it's often a matter of getting what you pay for. The question is whether the price is worth it. Here are some key areas to consider.

13.6.1 Reliability and repeatability

For a working professional, reliable and repeatable results are essential. Consider a radio trigger for a flash unit. A professional photographing an expensive model or actor, or covering a one-off event such as a wedding or news story, can't afford a flash misfire. An amateur, on the other hand, probably won't mind the occasional blank frame when the flash didn't go off, because they can simply try again. There may be a tenfold difference in price between an auction site garage door opener special and the best sync-only flash trigger, but that difference is trivial to a professional on a commercial budget, particularly compared to the cost of a missed shot.

Another example is the heat generated by a monolight. A professional doing an assembly-line shoot of children's school portraits, for example, will need to take thousands of photos a session, day in and day out. The flash must fire uncomplainingly every single time. But someone taking a few casual shots on the weekend probably won't need this sort of solid reliability. It's little more than an inconvenience to an amateur if a flash head overheats and shuts down until its thermal safety cutout cools; but such a failure can directly hit a professional's wallet.

13.54 Specialized units, such as this Elinchrom Quadra HS transmitter and portable flash head, are expensive but often have unique features. HS units are capable of syncing to much higher shutter speeds than most studio flash units.

13.6.2 Power and color consistency

Catalogue photos need to be precisely color-matched. Color variance can be extremely costly to a retailer, primarily in the form of lost revenue from customer returns. Someone photographing clothes for a catalogue, therefore, needs extremely accurate and repeatable color results. Not all flash units are capable of pumping the precise amount of electricity repeatedly through a flash tube to guarantee color accuracy, so the color temperature of a tube can vary slightly from shot to shot. Likewise, the brightness of the flash unit must be as consistent as possible for commercial work.

Again, this is an area that is largely irrelevant to the amateur. Color and brightness differences may be difficult to spot on consumer monitors, and can be fixed in software after the fact anyway.

13.6.3 Unique features

Pro gear may have other specific features to address professional requirements. For example, some studio flash units have very brief light pulses to freeze motion as much as possible. Others may have expensive computer interfaces to make it easier to adjust power output from a central location. Still others may have massive power output capabilities to light a huge studio set.

There are many reasons why pro gear is so costly. But the point here is not that affordable equipment is necessarily of poor quality. It's simply a matter of having realistic expectations, and of matching budget to equipment requirements as much as possible.

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Part D: Technique

Mysterious Al. In 1949, photographer Gjon Mili visited Pablo Picasso in France. Together they hit upon the idea of painting with light, which is simply sketching out a picture in the air using a flashlight in total darkness. Here artist Mysterious Al demonstrates the same technique at the Shunt Lounge and Theatre Company, London, England. Handheld 580EX II zoomed to 105mm fired at 1/32 manual power at the end of the drawing. EOS 5D Mark II, 25 sec at *f*/4, ISO 400, 29mm.

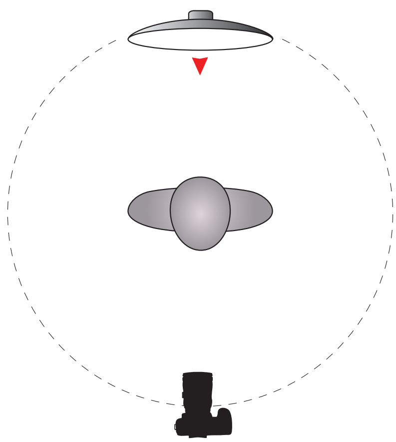
14 Basic Techniques

All the tech talk of the previous two chapters is really in the service of one thing: taking great photographs. Photos are nothing more than recorded patterns of light. The trick has always been to combine light and shadow in a way that's evocative, informative, moving, or simply interesting.

Flash photography is about taking control of shadows and light. Ambient or available light photography takes advantage of existing light conditions; but with flash, you have to make deliberate and very conscious decisions about what sort of photograph you want.

There are arguably four fundamental aspects of light that matter to a photographer: direction, intensity, quality, and color. The tools and technologies described so far are tools for guiding photons to do your bidding in those four basic ways. This is obviously a vast topic, and one that can fill many books, so the discussions of technique here really just serve as an introduction to the basics of lighting with flash.

14.1 Direction



14.1

The first basic property of light is direction, or simply where the light comes from. In everyday life, we're used to light from overhead sources—the sun or a ceiling fixture. We may want to simulate that effect in a photograph. Or we may want to avoid it altogether and go for something quite different. Take the sequence of photos on the next page.

This is a series of photographs of a model lit by a single studio flash unit. The distance between the light and the model never varied. The brightness remained the same. The only difference was the physical position of the light source, yet the mood changes completely from picture to picture.

The full-on frontal lighting shows the model's face well but has a very flat effect. The backlight results in a silhouette, emphasizing the form but losing the model's face. Side lighting brings a sense of dimensionality and drama at the cost of hard shadows. Top-down and bottom-up lighting tend to look exaggerated and unrealistic. Each direction brings a certain look to the fore, and whether that's good or bad depends on your goals and priorities. □ 14.1 and 14.2


6 o'clock (straight on)


7:30


9:00 (90° left)

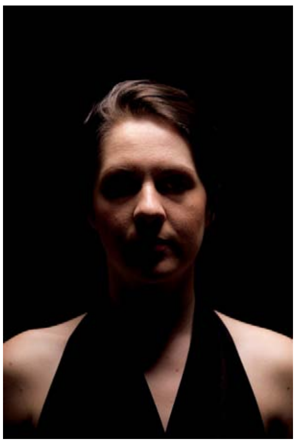

10:30 (45° left)


12:00 (directly behind)


1:30


3:00 (90° right)


4:30 (45° right)


Lit from above

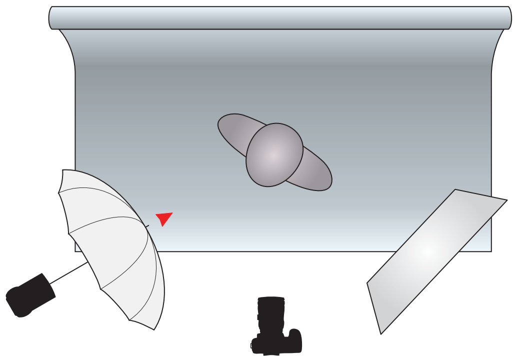

Lit from below

14.2

14.1.1 Short and broad lighting

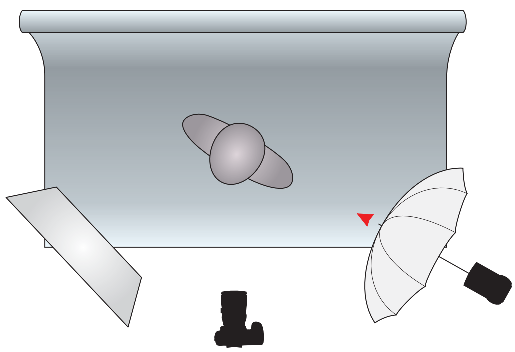
Two common approaches to lighting a person's face, when the person isn't directly facing the camera, are to position the main light source, the "key" light, on the subject's side that is facing the camera, or to position it on the side away from the camera.

14.3



14.4

14.5



14.6

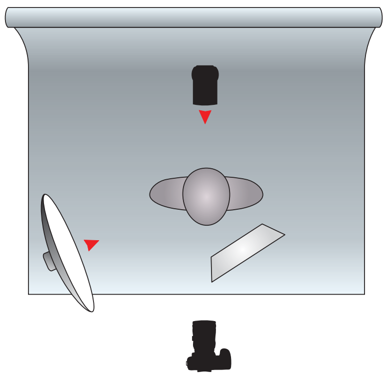
Short or narrow lighting refers to a key light positioned to illuminate the side of the face turned away from the camera. This tends to emphasize the shape of the face and is very common in studio portraiture. ☐ 14.3 and 14.4

Broad lighting refers to a key light illuminating the side of the face that faces or is closest to the camera. This can tend to make faces look wider and broader, so it is more often used for people with narrower faces. ☐ 14.5 and 14.6

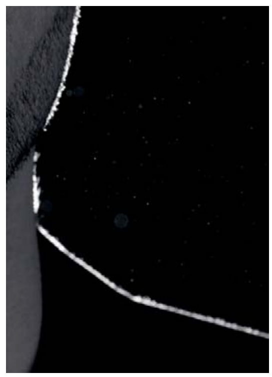
14.1.2 Multiple light sources

Multiple light sources can of course be combined from various angles to produce specific effects. This actor's headshot, for example, uses two light sources and one reflector. The key light is positioned slightly above camera left. A reflector is positioned below his face to "fill" in shadows. A small unit is positioned behind him to outline his hair and shoulders, in order to separate them from the black background. ☐ 14.7 and 14.8

14.7



14.8



14.9

Incidentally, this "rim" light has one side effect in this shot: tiny white dots that will need to be painted out in an editing program. These white dots are not, Internet rumor notwithstanding, spiritual orb entities, but simply specks of dust lit by the flash. They're most apparent in backlit situations with dark backgrounds, or when using built-in flash at night in dusty or rainy conditions. ☐ 14.9

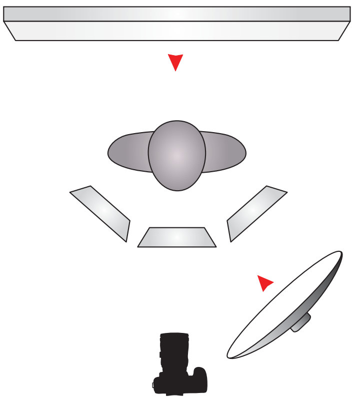
14.2 Intensity

Intensity is the brightness of the light. Most cameras are designed to meter everything to a mid-toned grey, but of course that isn't always going to be what you want. Exposure is as much an artistic decision as it is a technical one. Is the goal to create a bright, cheerful mood? A dark, somber one?

Two particularly pronounced examples of light intensity are high-key and low-key lighting.

14.2.1 High key

High key refers to lighting that's bright and even, with a light or white background. It's used a good deal in advertising to convey feelings of youth, friendliness, happiness, and so on. Medical and health advertising often uses high key to indicate healthiness and cleanliness. ☐ 14.10 and 14.11



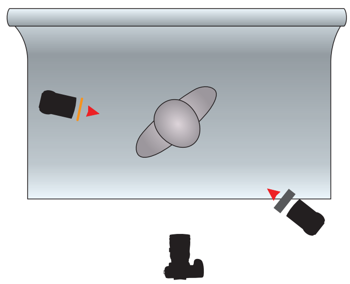
14.10

14.11 EOS 5D Mark II, 1/100 sec at f/6, ISO 100, 110 mm. The lighting arrangement for this shot is also seen in section 13.4.

14.2.2 Low key

Low key lighting, on the other hand, is darker and moodier. It's not simply a photo with the brightness turned down. Instead, it's a photo that emphasizes shadows and the shapes cast by them. Light is often used to paint the edges of things rather than fill them in. Film noir detective movies from the 1940s are renowned for their mastery of low-key lighting. ☐ 14.12 and 14.13

14.12 EOS 5D Mark II, 1/100 sec at f/2.8, ISO 100, Hartblei 80 mm Super-Rotator tilt/shift lens, 8° tilt. Speedlite 430EX with 1/2 CTO, camera left behind model. Speedlite 580EX with 1/2 CTO and Honl grid, camera right.



14.13

14.3 Quality

Quality of light doesn't refer to how fancy or expensive your gear is, but basically to the hardness or softness of the light. Consider these photos of a naturally occurring pyrite cube formation from Navajun, Spain. ❑ 14.14 and 14.15

14.14

14.15

The image on the left is lit by a flash unit located on the other side of the room. The light source is quite small relative to the subject, so it yields very sharp-edged, high-contrast shadows. Hard lighting is light in which the beam is tight and fairly parallel, with minimal spreading as it moves farther from the source.

The image on the right is lit by the same flash unit, but now the light is positioned close to the cubes, and behind a sheet of ordinary paper. The result is a larger area of light relative to the subject, so the shadows are much more softly defined. Soft light spreads out widely and bounces off everything.

Another classic example of quality of light is the sun. Although the sun is incredibly big, it's also incredibly far away. As a result, it doesn't fill a very big area of the sky when seen from our planet. On a bright cloudless day, particularly at high altitudes, the sun is almost a point light source, emitting directional light and casting very sharp-edged, high-contrast shadows. But on an overcast day, the entire sky becomes a giant softbox. Light is almost shadowless, since it's striking everything from multiple directions at once.

Take the two photos on the next page. The latest space probe photos of one of Saturn's moons? No, just the end of an ordinary chicken egg. ❑ 14.16

The left-hand shot was taken using a bright studio flash unit reflecting off a white ceiling. The entire ceiling thus became a reflective surface, resulting in soft lighting.

However, the right-hand shot was taken with a small Speedlite flash unit, zoomed out to 105 mm and positioned camera left. The result is a hard and intense light, sometimes called a "raking" light, which brings up the interesting texture on the egg's surface. Photographers of ancient manuscripts and archeological artifacts often use raking light to reveal otherwise unnoticed surface detail.

14.16

Hardness or softness of light significantly affects all types of photography. It's particularly an issue for portraiture. Hard light emphasizes slight facial blemishes, and is one reason why snapshots taken in restaurants and pubs aren't desirable for user profiles on social networking sites.

14.3.1 Achieving soft light

Portable camera flash units are essentially designed to work like spotlights and have small light-emitting areas—about one-third the size of a playing card. This is partly for portability reasons, and partly because flash units are designed to achieve the maximum distance range possible by concentrating their light output with a reflector and lens. Any softening of the light necessarily involves a reduction in efficiency and range.

There are two basic ways to soften light: reflect it off a large surface, or diffuse it through a large surface. Either way some light will be lost, but the tradeoff comes in light quality.

When using a battery flash unit, bouncing light off large white surfaces such as white walls or ceilings is one way to use the first technique. Remember that colored surfaces will add a color cast to the light—something to be aware of when bouncing light in interior spaces. A blood-red wall will reflect red light onto the subject, which may or may not be the desired effect.

Many of the large flash diffusers described in section 12.5 employ the second technique, increasing the size of the light-producing area. Studio softboxes and shoot-through umbrellas also use this method. They must be positioned close to the subject to provide truly soft light, however. A large softbox positioned a long way from the subject will provide light that's as hard as a smaller light source close at hand.

Of course, having said all that, hard flash lighting isn't some pernicious evil forever to be eschewed. It's just good to start with the benefits of soft light, then move into mastering hard light later, as discussed in the next section. □ 14.17

14.17 This photo was lit by a medium-sized softbox with an Elinchrom monolight camera right. A reflector under the model's chin filled in the shadow.

14.4 Color

Contemporary photography is usually about color, black and white having lamentably fallen into the niche fields of art and education in the 1980s. As discussed in the section on color temperature (section 7.18), there are many complex subtleties about white light and the way it's perceived by the human brain.

Flash units are designed to produce a fairly neutral white light similar in color to daylight. Portable units like Canon Speedlites typically have a color temperature of around 5500K. Studio lights sometimes have slightly bluer light, up to 6000K or so. Regardless, the light is quite blue compared to ordinary tungsten lights and LED bulbs that are designed to simulate tungsten.

Accordingly, it's important to keep light source differences in mind when shooting. The preview screen on digital cameras, while not a perfect rendition of the finished results, can be a useful tool for checking how the camera sees the scene compared to the way the eye sees it. This is particularly important for long shutter times. ☐ 14.19 and 14.20

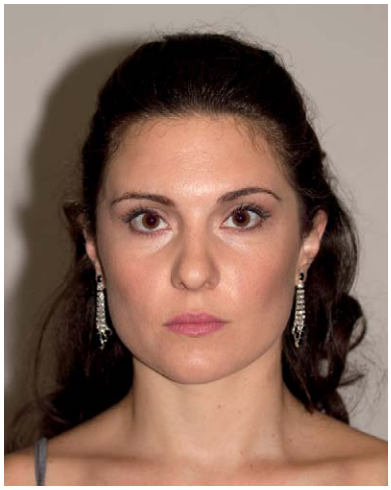
14.18 CTO (orange) filters are needed to get the blue-white light of a flash unit to match the warm light from the practical on-set tungsten and candle lighting.

14.19 Cooler color balance.

14.20 The same photo with a warmer color balance. Which shot is better is a matter of opinion. The blurring effect was created by a Hartblei manual focus tilt-shift lens set to maximum tilt (8°).

14.5 Basic Speedlite portrait photography

This sequence of photographs shows different approaches to lighting a person using a single flash unit.



14.21 This photo was taken using an EOS 50D's built-in flash, which resulted in harsh, unflattering light and a sharp-edged flash shadow.

14.22 The next step was to add a shoe-mount flash unit. Here a 580EX II was used on the same 50D. It isn't vastly better.

14.23 Next, the flash unit was angled upwards to bounce light off the ceiling. The room had eight-foot ceilings painted white. Accordingly, enough light bounced around the room to fill in the shadowed areas.

14.5.1 Bounce flash

Direct flash—a flash unit pointing straight ahead—is an efficient means of illumination, but it is rarely flattering. The light is harsh because it originates from a very small area relative to the subject. Fortunately, most Speedlites have the ability to tilt and swivel the flash head independently of the flash body. This can send light bouncing off walls, ceilings, reflectors, bystanders, etc. Bouncing light in this way means that the light reaching the subject originates from a larger area than the flash head and is therefore softer. ☐ 14.24

14.24 Bounce flash off the ceiling can produce a soft and consistent look, which is often a good thing. Here the flatness of bounced light is used to emphasize the drabness of the hotel room.

Bounce flash can soften light nicely but has disadvantages. For one, it obviously isn't possible to bounce flash outdoors without a reflector or something that can serve as one, so the technique is most immediately useful in interior spaces. Some interiors, in fact, aren't much good either if they have really dark surfaces or high ceilings. Another drawback is that colored surfaces (such as painted ceilings or walls) can end up tinting the light from the flash, resulting in unwanted color shifts.

Relying purely on ceiling bounce flash can result in unattractive shadows appearing under the eyes and nose, sometimes referred to as "raccoon shadows." The traditional approach to filling in these shadows has been to elastic-band an index card around the back of vertically pointing flash

heads in order to bounce a bit of light forward. Some Speedlites, in fact, have built-in, pull-out catchlight cards.

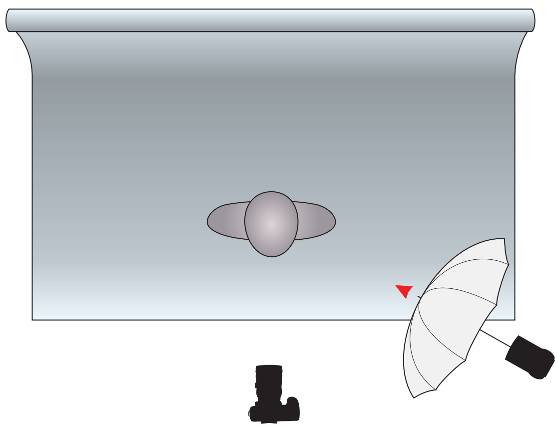
Finally, bouncing the light reduces the amount of light hitting the subject, and this easily costs about half the range. For this reason, it's sometimes necessary to use a higher ISO setting or a larger lens aperture with bounce flash. Remember that increasing the shutter speed won't help at all, since flash durations are too brief to be affected by shutter time.

14.6 Building a studio portrait

Bounce flash with a single flash unit is a useful technique for quick photos on the go, but it doesn't yield much control over lighting a scene. The traditional studio portrait, in contrast, has long been a structured, multiple-light affair. Here is one approach to building a studio portrait using only Canon Speedlites.

14.6.1 External flash off-camera with shoot-through umbrella diffuser

14.25

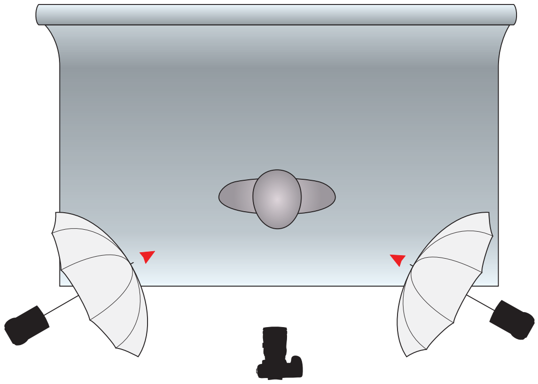


14.26

The flash unit is moved off-camera onto a light stand. It's a 580EX II assigned to group A, and it's fired using wireless E-TTL by an ST-E2 transmitter located on the camera. The flash unit is set to fire into a shoot-through umbrella to camera right, at about a 30° position. This is the dominant light for the photo, known as the "key" light.

14.6.2 Two off-camera flash units with shoot-through umbrellas

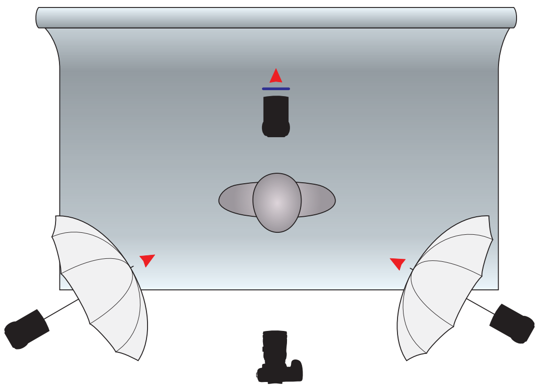
14.27



14.28 Now the model is lit by a pair of shoot-through umbrellas, one located on either side of the camera. One has a 580EX II assigned to group A; the other has a 580EX assigned to group B. Both are still controlled by an ST-E2. The second light fills in the shadows so that they aren't too dark, and therefore is known as the fill light.

14.6.3 Two off-camera flash units with shoot-through umbrellas, one background light

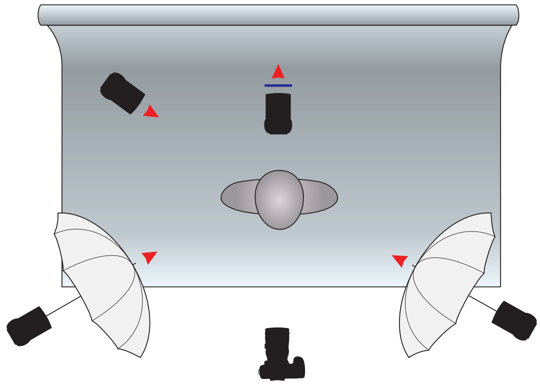
14.29



14.30 Same as above, but a third Speedlite is added immediately behind the model, illuminating the backdrop. This helps add contrast between the subject and the background, providing a little dimensionality. Since the ST-E2 can't control group C, this flash unit has its output set manually. Additionally, it has a blue filter, but no diffuser or umbrella.

14.6.4 Two off-camera flash units with shoot-through umbrellas, one background light, one hair light

14.31



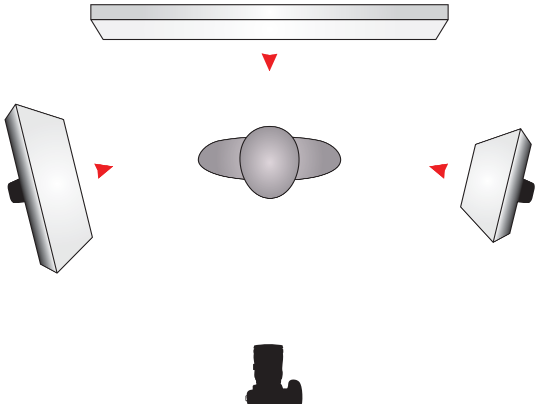
14.32 Finally, a fourth Speedlite is added to skim the model's hair. This is a 430EX II, also set manually and zoomed out to 105 mm.

14.7 Experimenting with light

The traditional approach to taking a photo uses three-point or four-point lighting, as demonstrated in the previous section. While it yields perfectly nice results, ready for the corporate bio or the school yearbook, it's fair to say that the portraits in figures 14.33 and 14.35 won't win any prizes for original lighting. Sometimes simpler can be more interesting. ☐ 14.33 and 14.35

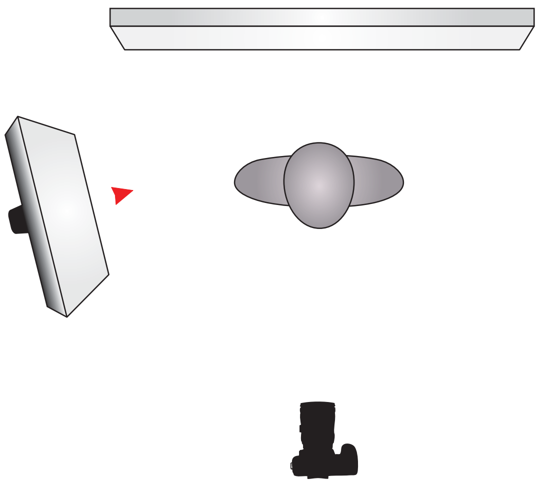
The two portraits here were taken consecutively, with lights positioned in identical locations. The first image has a large softbox camera left, a light with a small diffuser camera right, and a self-illuminating Lastolite backdrop. The second image is identical, only the backdrop and camera right lamps are switched off. Just one softbox, with a little spill onto the white backdrop, turning it gray. Yet this style of lighting, known as split lighting, is perhaps more flattering to the subject and is certainly more dramatic.

14.33



14.34

14.35

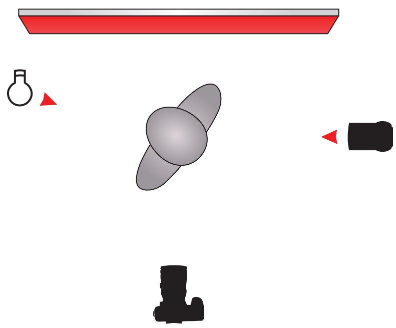


14.36

There's also a lot that can be done by combining staging with lighting. The remaining photos in this section were designed to show interesting flash-illuminated shots but without any complicated equipment requirements.

The next shot was quite simple to set up. In fact, it was a quick photo taken during preparations for a fashion event. The model had just been bodypainted (her "corset" is in fact entirely painted on) and she was getting ready to leave.

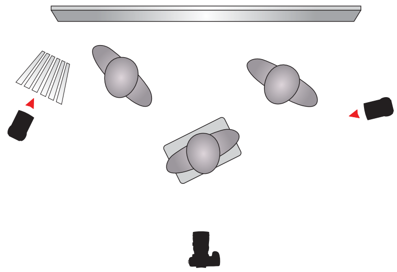
The key light is a Speedlite 580EX zoomed out to 105 mm, with no modifiers, positioned on a portable lightstand, camera right. It was triggered manually at quarter power using a generic radio remote. A tungsten bulb positioned camera left provides a small amount of subtle fill, mainly on her left hand and shoulder. That's it: the Speedlite lit the model's back and the red-paneled wall, resulting in a shadowed silhouette of her face.



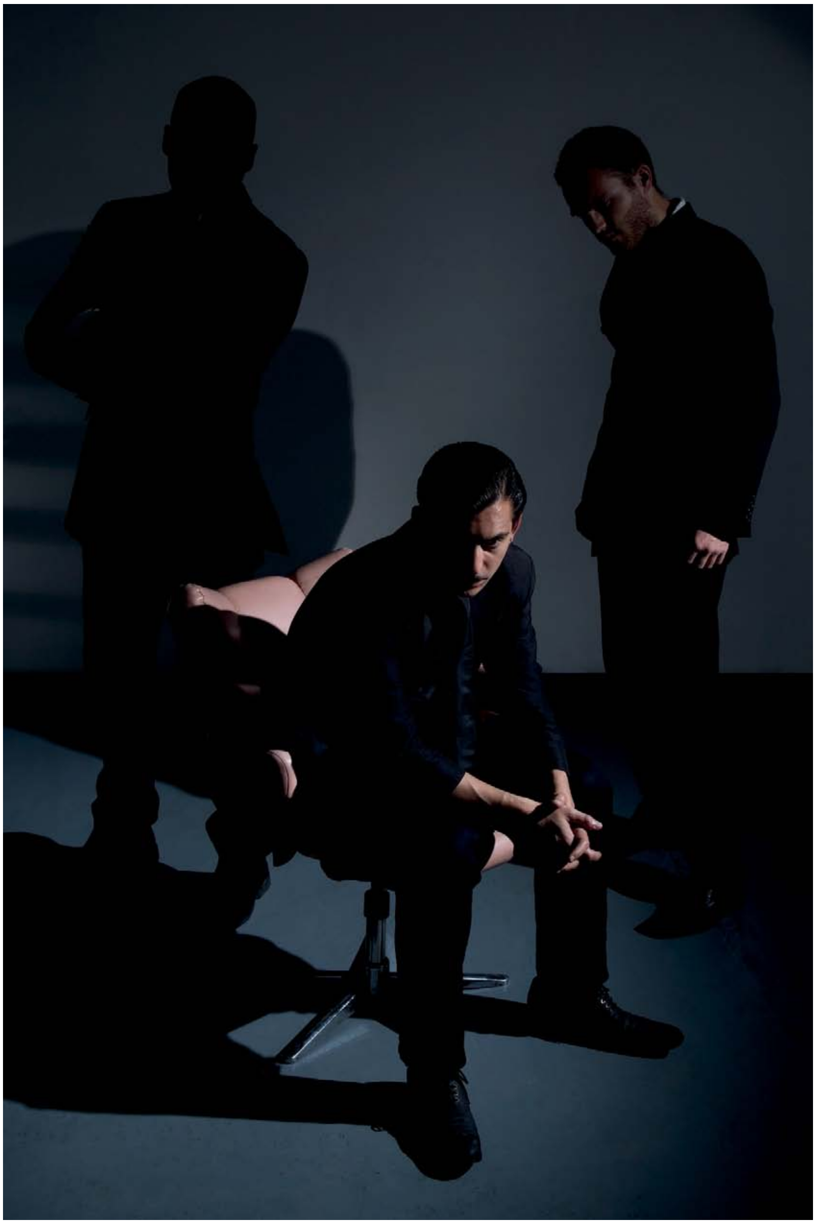
14.37

14.38

The next shot is slightly more complex, and was constructed intentionally to convey a bit of narrative. The idea was to suggest a hoodlum being interrogated by a fellow gangster to the right. But hidden in the shadows stands the real power figure. No props were used other than the chair, which gives the sense of a bleak empty warehouse.

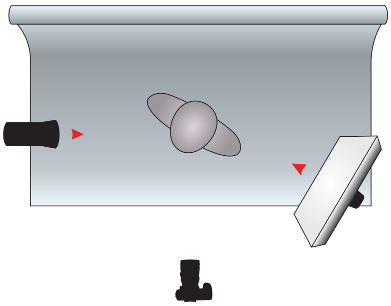


14.39



14.40

The photo was shot using wireless E-TTL controlling three Speedlite flash units. A 580EX was used on-camera as the controller but did not contribute light to the scene. A 580EX II was positioned camera right on top of a six-foot light stand with its flash head set to 105 mm. This created a spotlight effect shining downward over our hapless hoodlum. This flash was positioned to spill slightly to the right-hand gangster. A 430EX, also set to 105 mm zoom, was positioned camera left in front of a cardboard grid to create patterns, like a crude windowblind effect, on the wall. This provided enough back illumination to shadow our Mr. Big.



14.41

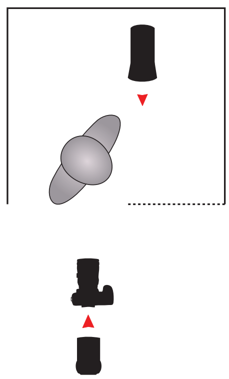
14.42

The next shot was designed to give a sense of theatricality, as though our elaborately costumed figure is reaching in vain for a spotlight on a distant stage. The backdrop was plain black paper so as not to distract from the foreground interest.

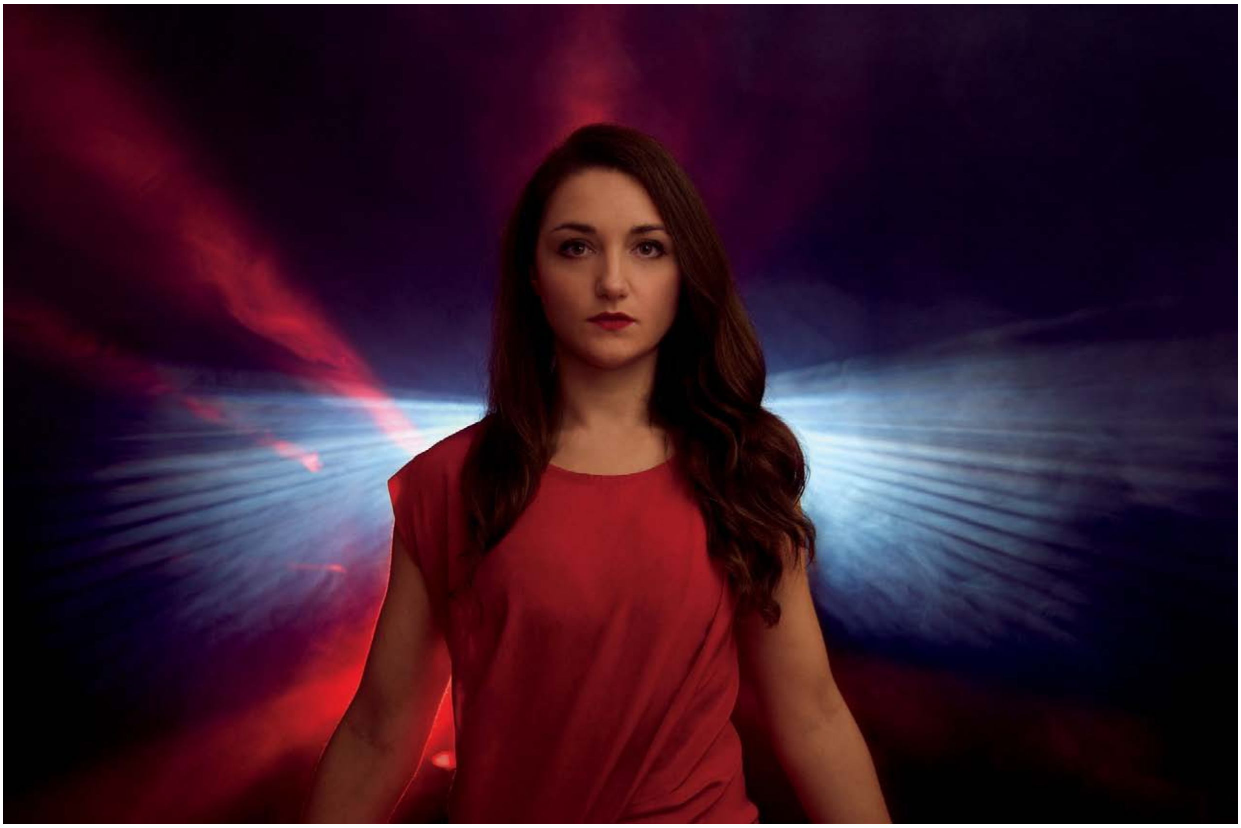
Compositionally it deliberately mixes hard light with soft light. A large softbox with studio flash was positioned camera right, providing soft key lighting for the portrait and illuminating the complex costume. To camera left, however, I positioned a studio flash unit with a simple "spill kill"

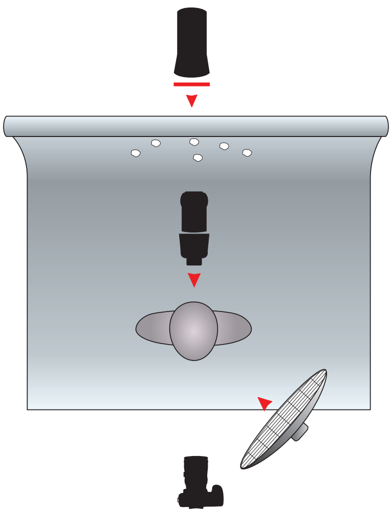
reflector and no light modifiers for a deliberately hard form of lighting. This light illuminates our subject's hand and sleeve, with some spill on his face. However, his lower front is in shadow.

The above shot combines Speedlite and studio flash, and was shot on location inside an old freight elevator. The portrait employs foreground fill from an on-camera Speedlite 580EX firing manually. It was dialed down low to prevent the model from looking too flat. A large Bowens studio unit (with a simple spill kill reflector but no modifier) was positioned behind the model and the gate, aligned to provide some direct light into the lens to create a visually interesting glare, and was triggered optically by the onboard flash. A haze machine was used to lower the contrast, diffuse the backlighting, and reduce some of the details in the somewhat uninteresting elevator.



14.43



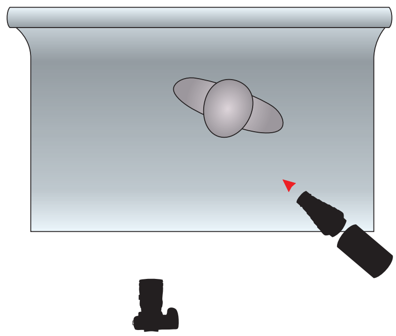


14.44

The layering effect of smoke is a useful and affordable tool. For this example, I wanted rays of light to appear behind the model in the photo above. The technique was actually pretty low-tech. I took a roll of black backdrop paper and cut a handful of small holes in it. I then placed a high-powered studio flash, gelled red, behind the paper, and positioned a low-cost party smoke machine between the model and the backdrop. A little experimenting with the alignment of the flash unit yielded interesting directional rays. The model was lit with a beauty dish, which was equipped with a grid to prevent spill onto the backdrop. The final element was a 35mm photographic slide depicting a stylized pair of wings. I used a Light Blaster (see 12.9) behind the model to project the slide onto the smoke itself. Obviously this shot could easily have been done with an image editing program, but the whole point was to do it in-camera. ☐ 14.44

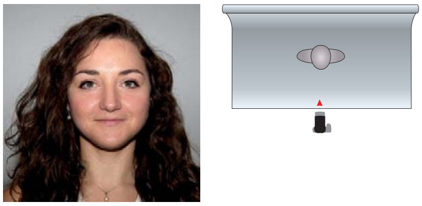
This last photo was an obvious homage to the low-key look of 1940s *film noir* movies. The model playing my hardboiled reporter is holding a Speed Graphic press camera with Graflex flash, and wearing a suitable fedora. He's lit by a single Elinchrom Style 600 studio flash unit, which is positioned to rake light obliquely from the right. The flash unit has a snoot (section 13.4.8), which restricts the light output, projecting a loose circle. Sort of a spotlight on a budget. The result is a bold and dramatic photo, with sharp shadows casting strong graphic forms.

The key to effective lighting is always to experiment with different lighting positions and types. The next section has some other starting points for more creative exploration.



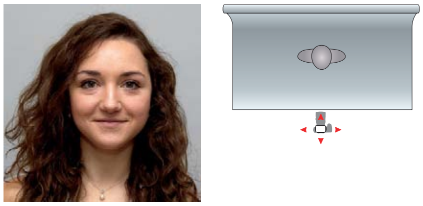
14.45 This photo, for example, was taken with a single flash unit to camera right. The Elinchrom Style 600 had a snoot installed (section 13.4.8), which projects a circle of light, almost like a spotlight.

Direct on-camera flash



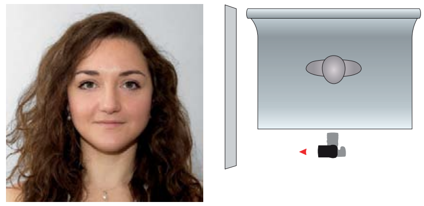
Direct camera-mounted flash.
Horrible. Don't do this to your friends!

On-camera flash, ceiling bounce



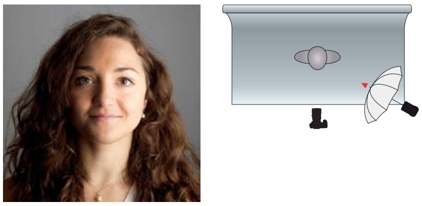
The on-camera flash is pointed toward the ceiling, which reflects the light off a large area, but tends to result in shadows under the eyes. The flash unit's pull out card yields a bit of a catchlight in the eyes.

On-camera flash, wall bounce



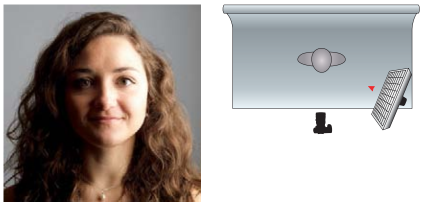
The on-camera flash is rotated to point at the left-hand wall. This can produce soft lighting with some shadows on the right, depending on the size of the room.

Rembrandt lighting with umbrella



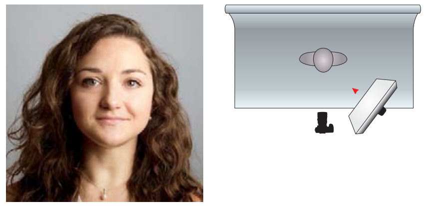
A shoot-through umbrella is camera-right at about 45 degrees and slightly above the face. This yields soft lighting, with some nice sculpting of the shadows and the signature light triangle on the cheek. Umbrellas bounce light everywhere, filling shadows.

Rembrandt lighting with gridded softbox



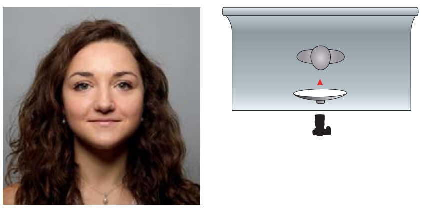
Same as left, but a medium sized softbox is used. A fabric grid reduces off-axis spill, resulting in less light bouncing around the room. This is why this shot has more shadow on the unlit side of the face.

Loop lighting



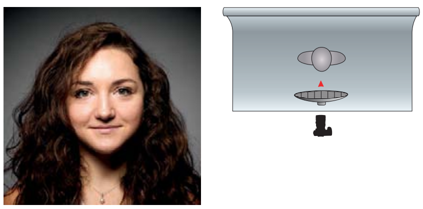
Similar to the Rembrandt, but the softbox is slightly closer to the camera. This reduces the amount of shadowing on the far side of the face. The shadow between nose and chin isn't linked, so there's no cheek triangle. Instead, a curved C-shaped loop of shadow is visible under the lower-left edge of the nose.

Butterfly lighting (diffused beauty dish)



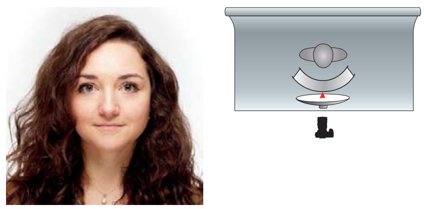
A metal beauty dish was placed directly above the camera, in line with the axis of the lens, though a softbox or umbrella could have been used instead. This creates the characteristic butterfly shaped shadow under the nose. A white fabric sock was put on the dish for soft diffused light.

Butterfly lighting (beauty dish with grid)



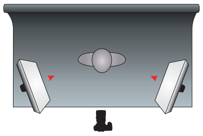
The diffusing sock was removed, and a fine metal grid was added to the beauty dish in its place, reducing the amount of general spill and concentrating the light. The white backdrop is grey in shadow around the periphery, and shadows appear on the edge of the face.

Clamshell lighting (diffused beauty dish with reflector)



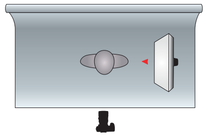
An overhead beauty dish is used as at far left. However, a light or reflector is also placed directly beneath it, shining upward. A large curved Eyelighter was used in this case. Normally light from below produces a somewhat ghoulish look but, combined with the light from above, the clamshell method produces a bright and cheerful look that's popular with beauty advertising. The lower reflector fills in under-eye shadows.

Flat lighting

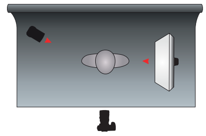
Two medium-sized soft boxes were used, one to either side. Each had the same light output. The result is soft and even, almost shadowless, lighting. The lack of sculpting makes the shot a bit dull.

Split lighting

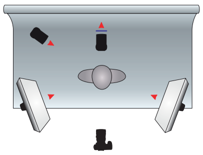
A softbox is positioned 90 degrees to camera right. This divides the face into two halves – shadows and light. A bit too dramatic for most applications. The backdrop is actually white paper, but far enough away from the subject that it's poorly lit and records as gray.

Split lighting with hair light

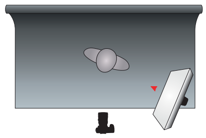
Same setup as above, but a black backdrop throws the entire photo into tenebrous shadow. A flash is positioned camera left over the shoulder, to illuminate the edge of the hair so it doesn't vanish entirely into the darkness.

Three point lighting and background light

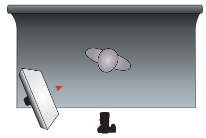
As shown on page 316, the traditional three-point setup uses a main or key light (in this case camera right), with shadows filled in using a smaller or lower-output fill light (in this case camera left). A third light is used in the background to skim the edges of the head to highlight the hair. In this example, a fourth, and blue-gelled, light is also used to change the color of the background from gray to blue.

Broad lighting with softbox

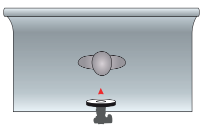
In this shot the face is angled and a softbox is used to illuminate the near side of the face. This type of lighting is bright but tends to over-emphasize the shape of people with rounder faces.

Short lighting with softbox

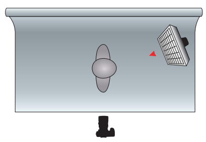
The opposite of broad lighting. The light source is used to illuminate the far side of the face, resulting in a more narrow slice that's lit. This type of lighting tends to narrow the face.

Ring flash

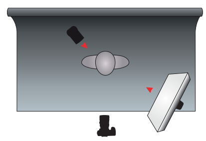
A ring flash is attached around the camera lens providing an oddly flat and shadowless look. It also creates the characteristic white doughnut catchlight in the eyes and a dark halo shadow.

Rim lighting

A narrow softbox (striplight) is placed camera left, and behind the model so that only the edge of her face is outlined. The striplight is gridded to minimize the amount of stray light hitting the gray backdrop, rendering it totally black.

Cross lighting with visible backlight

Cross lighting refers to lights that are positioned 180° and pointing at each other. In this case a large softbox is positioned camera left to yield a Rembrandt lighting arrangement. A flash unit in the background is positioned opposite to illuminate hair and shoulders. For extra drama the back light was moved right so it appears in the frame.

15 Advanced Techniques

Blue Water Drop. 580EX II with blue gel, positioned behind a sheet of white paper, to light the water surface. 430EX II with red gel located camera right to illuminate the drop. ST-E2 as wireless E-TTL trigger. Shot in a glass of water in my studio. *f*/6.3, ISO 100, 100mm macro.

15.1 Two separate flash units were used to freeze the fire performer's body and the background. The slow shutter speed captured the swirling motion of the fire staff. In this instance, the camera was motionless.

The previous chapters in this book deal with figuring out the fundamentals of flash photography. This final section is a compendium of ideas of other directions to explore.

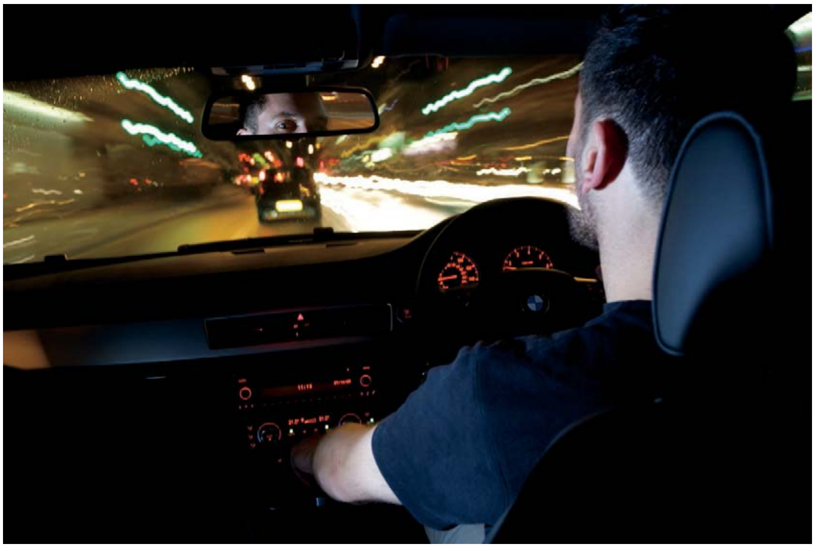
15.1 Slow shutter sync and motion

Slow shutter sync and its usefulness for exposing a background correctly with low light levels were discussed early on in this book. Also mentioned was the importance of using a tripod to reduce motion blur in areas not illuminated by flash.

The same principle can be deliberately exploited to take advantage of motion blur for dynamic effect. Essentially, a photo taken with flash and a slow shutter speed can provide an interesting mix of frozen flash-illuminated subject and ambient-light-illuminated motion blur. The effect isn't always easy to predict, but it can be very striking and exciting when it works.

15.2

15.3 Another trick is to adjust the position of the zoom lens during the course of a slow sync exposure. In figures 15.2 and 15.3, flash is used to freeze the foreground, and the zoom motion causes dynamic blurring outwards.



15.4 A classic use of slow shutter sync is this shot of a car interior. A flash unit, carefully positioned so as not to distract or blind the driver, was used to illuminate and freeze the car interior. The two-second exposure nicely blurred the lights visible through the windshield.

15.2 Hard isn't all bad

Introductory material for beginners make it sound as if hard light is malevolence in photon form, and that professional studios have nothing but huge softboxes in them. This isn't the case, of course. Light that's too soft can be boring and flat. Shadows define a picture as much as light, and skillful photography is as much a matter of choosing and positioning good light sources as it is composing the elements of the scene.

15.5 Direct flash is also useful for illuminating iridescent insects. This male banded demoiselle damselfly *(Calopteryx splendens)* was photographed with on-board direct flash mainly to help freeze motion, since I was in a bobbing rowboat at the time. However, the direct flash also helped bring out the insect's magnificent metallic sheen.

15.6 A group of masks from Jiichi Asami's working collection of Japanese Noh theatre masks. The masks were side lit by a single 580EX II Speedlite.

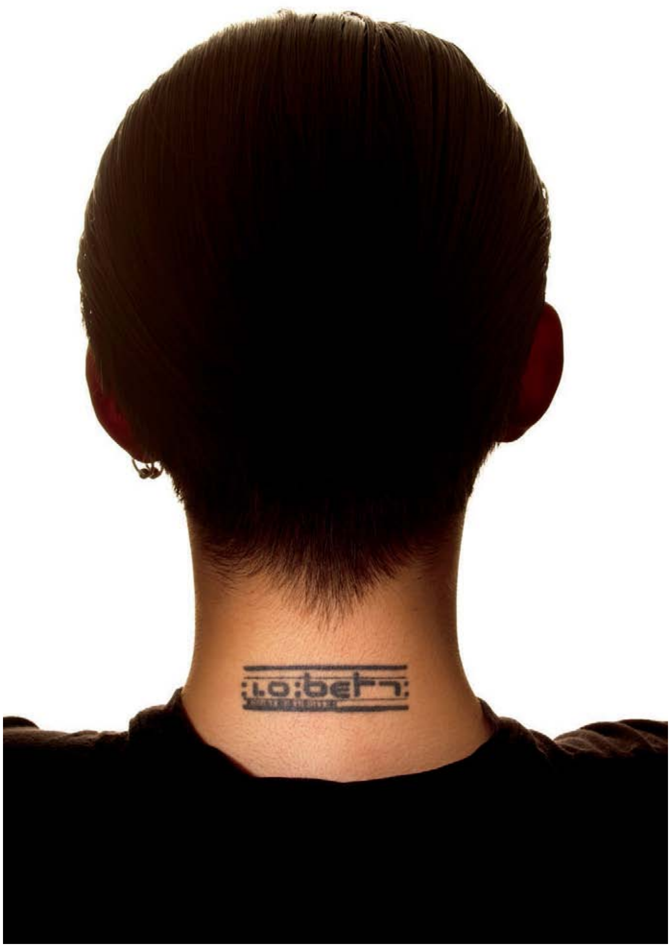
15.7 This photo of author Cory Doctorow at his desk was taken using two 580EX Speedlites triggered by an ST-E2. One 580EX was filtered 1/2 CTO and positioned camera left to rake along the bookcase. The other was filtered blue and positioned on the floor to illuminate his handcrafted raygun, which he uses to defend Earth from malevolent space invaders and the evils of DRM. No light modifiers were used other than the filters.

15.3 Narrowing down the light

Standard automatic flash lighting systems emphasize getting as much light on the scene as possible. But brightly lit scenes can be a bit boring. Spots or patches of light in shadow can make for much more interesting pictures. Think of the dark chiaroscuro or tenebrist paintings of 17th century artists such as Caravaggio: shadowed scenes with pools of light gathered around, or hinting at, mysterious narratives.

The zooming mechanism in most portable flash units is a great tool for narrowing down the cone of light from the flash head. Some photographers think of the zoom as a "portable snoot" rather than a mechanism to compensate for focal length. Naturally, the zooming mechanism has to be under user control, but fortunately most Speedlites have manual zoom override.

Add-on flags (light-blocking panels), snoots, and grids are also useful tools for keeping the light focused in one place.



15.8 This shot was taken with two lights. One was a large Elinchrom studio flash unit inside a large Lastolite HiLite box (section 13.4.6). This provided a silhouette of the subject, since there was no foreground lighting. The second light was a 580EX in manual mode, equipped with a Speedlight Pro Kit add-on grid. The Speedlite was aimed by hand at the subject's neck in order to focus an oval patch of light on his tattoo.

15.9 A Honl grid was used to concentrate the light from a Speedlite 580EX II onto the nautilus shell.

15.10 This shot of ceramic artist Andreas Alefragís used a single CTO-filtered Speedlite 580EX II, positioned camera right and shooting through a large sheet of transparent bubblewrap. This created the effect of the photo being taken in late evening light.

15.4 Backlighting and flash in the frame

One of the first rules most beginners are taught is never to point a camera toward the light source. This is a useful rule for learning how to meter, but backlit scenes can be quite interesting.

15.11 Mobius Arch, Alabama Hills, California. This photo was a two-minute exposure taken at moonrise. A 580EX II was fired from behind the arch to outline its inner edge and provide an unusual burst of light. The tall mountain visible through the arch is Lone Pine Peak. The mountain to the very far right is Mount Whitney, the tallest mountain in the contiguous United States.

15.12 This picture was taken using two Speedlites mounted back-to-back on a light stand. One had a red filter and was pointed at a white wall. The other faced the camera and backlit the model, creating a silhouette with an outline of white.

Silhouettes are a particularly dramatic way to light something. Even showing the flash in frame can bring in a sense of drama. Positioning a light to the side of the subject, but behind it, can give an attractive halo of light, helping separate the subject from the background. This technique lends itself to manual metering, however. Automatic metering tends to underexpose badly if the flash unit is visible, since it's designed to record reflected light and not direct light.

15.13 This portrait was lit by a beauty dish, out of frame, and a Bowens ringlight with translucent glass diffuser, very obviously in frame.

15.5 Kill the ambient

As discussed in section 6.3, each flash exposure is essentially a double exposure—there's the subject lit by flash, and the background, which may be lit by ambient light. In the case of night or other low-light conditions, it's fairly easy to reduce shutter times to minimize the amount of light contributed by ambient without affecting flash. But in daylight, this becomes trickier, because the X-sync limit puts an upper ceiling on the maximum attainable shutter speed.

Fortunately, high-speed sync means that X-sync is easily broken. You can set a high shutter speed to keep ambient exposures low while exposing the foreground normally using flash. This technique can create moody atmospheres under what appear to be fairly uninteresting or banal lighting conditions.

15.14 This shot was lit by a 580EX firing into a California Sunbounce reflector. As can be seen by the dark shadow to the model's right side, she was lit primarily by flash.

15.15 You knew it was coming, didn't you? What book on flash photography would be complete without a picture of somebody pointing a flash unit at his own head? This off-camera 420EX was triggered by an on-camera 580EX II using ordinary wireless E-TTL. High-speed sync was used for a shutter speed of 1/400 sec at *f*/6.3 despite the bright sunlight. The camera was an EOS 5D Mark II, which has a maximum X-sync of 1/200 sec.

15.6 Cookies

A basic lighting tool for cinema and stage is the “cookie,” short for “cucoloris.” The best part about “cucoloris” is that nobody seems to know where the word comes from. Whatever its etymological origin, a cookie is simply a flat board with holes cut into it. Or a piece of mesh with fabric leaves stuck on to it. Or a bunch of branches. Or a glass of water. Or anything, really, used to break up light into interesting shadows.

Speedlite-type flash units are ideal for working with cookies because the hard-edged light from a battery unit automatically wants to cast sharp shadows.

15.16 This photo is simply a blank white wall with a houseplant positioned to the left, out of frame. A blue-filtered Speedlite 430EX was put behind that.

15.17 Here’s a portrait taken in front of the same wall. The filter was changed to red to match the model’s corset, and a beauty light was used camera right as the key light.

15.18 What appears to be the shadow of a mighty bird is actually an ordinary household electric fan positioned in front of a Speedlite 580EX II. A straw-colored filter was used to give the feeling of late afternoon light.

15.7 Open flash

A fun way of taking interesting photos in the dark is to use open flash, described in sections 5.5 and 11.2. It’s certainly the most direct way to apply light to a scene.

The basic technique is to lock the camera to a solid tripod, find a location with little or no ambient light, and then open the camera’s shutter in “bulb” mode. This is best done with a remote that can be locked in the open position. Then it’s just a simple matter of walking around the scene, firing the flash by hand to illuminate areas of interest. Colored gels can be taped over the flash head to illuminate the photo with different colors of light.

15.19 The Neverwas Haul

15.20 By comparison this snapshot was taken using direct on-board flash. The image looks flat and lifeless, and dust motes in the air are illuminated.

15.21 It's been done before, but it's still a lot of fun. This picture of the windmills in Oia Santorini, Greece, had a very long shutter setting to record the faint light of dusk. Then I took a 580EX II with a blue gel and ran past the right-hand windmill, firing the flash once by hand as I jumped. EOS 5D mark II. 10 seconds at *f*/6.3, ISO 200, 45 mm.

The Neverwas Haul shown in figure 15.19, a self-propelled three-story art vehicle in the form of a Victorian house, was created by the Travelling Academy of Unnatural Science. In this shot, the Haul was lit primarily by the full moon, camera left. The lengthy exposure, nearly a minute and a half, made the picture look like it might have been taken in late evening light. The keen-eyed observer will notice that there are two shadows cast by the vehicle, hinting that there was also a large light tower camera right, positioned a good mile away.

The vehicle is outlined by handheld flash triggered manually. A 580EX II was fired at full power at various positions around the vehicle and through its port-side windows to backlight its steering wheel. The flash was colored using red and blue filters for effect. More subtly, there was also a single half-power burst fired onto the left side of the vehicle, with a 1/4 CTO filter, to fill in the shadowed areas by the wheels and the staircase. EOS 5D mark II. 70 seconds at *f*/7.1, ISO 100. 35mm.

Canon Speedlites with manual controls or old flash units with manual metering are ideal for this application, since the output power can easily be adjusted. It helps to wear dark clothing and point the flash away from one's body. Naturally, a flash unit isn't the only tool for doing this sort of photography. People often take outdoor night scenes using high-powered floodlamps, or indoor photos with small flashlights (electric torches) or blinky light toys.

15.8 Stroboscopic (MULTI) flash

"Stroboscopic" photography is the process of firing a sequence of brief flashes during the course of a single photographic exposure. The result can capture the steps of a dancer in motion or the swing of a golfer, like the classic photographs that Harold Edgerton took in the 1940s and '50s. Each frozen moment is recorded on the same frame, like a multiple exposure.

The ingredients required to take a stroboscopic photo are a Speedlite (or other flash unit) with stroboscopic capabilities, a very dark background, and a relatively light-colored moving subject. Reflective or light backgrounds don't usually work because the multiple pops of light will build up cumulatively to overwhelm the foreground subject. Put the camera on a tripod, install fresh batteries in the flash unit, use either M (metered manual) or Bulb modes, and ideally use a remote shutter release. Multiple Speedlites can be controlled wirelessly for more light output if necessary. Stroboscopic mode is not compatible with second curtain sync or high-speed sync. ☐ 15.22 and 15.23

The 400EZ series and all 500 series Speedlite flash units have built-in stroboscopic flash capabilities, known in the Speedlite menu as "MULTI." All models can specify the number of flash pulses per second (i.e., the frequency in Hertz), as well as the length of time the flash unit will fire. Some can also specify the total number of shots to be taken per exposure, but

older models require this to be calculated by hand. The full details for engaging stroboscopic flash are described in section 9.21.

Note that there are some practical limits posed by stroboscopic lighting. First, a flash unit can only fire a certain number of times before it overheats, so it can't be pressed into service as a disco strobe light at your next party. It also can't fire full-power pulses very rapidly, since the unit needs time to recharge its capacitors. For this reason, Speedlites are pre-programmed with flash frequency and power limits.

15.22 The complex motion of an aikido throw, captured as a sequence of freeze frames.

15.23 A 580EX II pulsing at a relatively slow one-flash-per-second (1 Hz) was used to capture the movement of the dancer's fans. The flash head was zoomed to 105mm to create a spotlight effect.

15.9 High-speed photography

While flash units are used today mainly as a photographic light sources, the flash tube was originally used as a device for stopping time—at least, photographically speaking. In the mid-1920s, MIT's Harold Edgerton was studying the behavior of synchronous electric motors. He had made some calculations predicting their performance and built a mercury arc lamp that could photograph the spinning motors as they were put under load, thereby testing his theories. Over the next few years, he generalized the concept for photographic applications, eventually switching to xenon gas in the tubes. Edgerton was following in the footsteps of photographic pioneer William Henry Fox Talbot, who in June 1851 used an electric spark to freeze the motion of a sheet of paper fastened to a rotating disc.

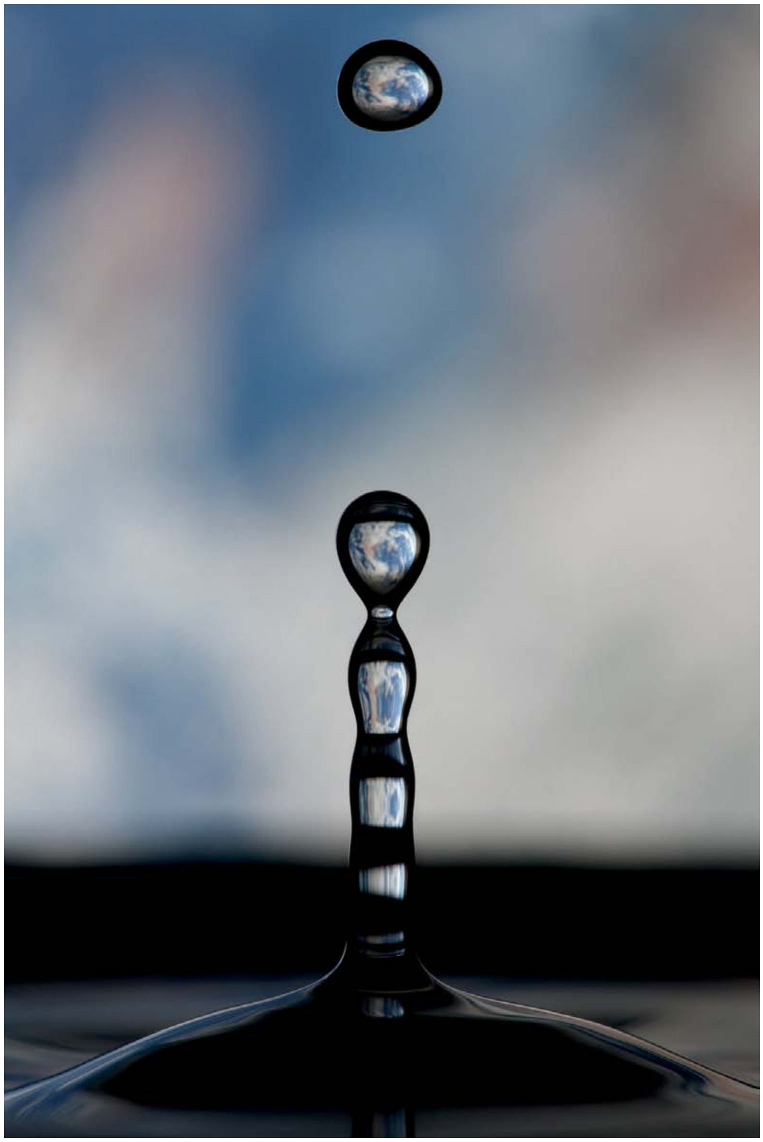
Today, the same photographic flash units that are used for snapping photos can be used for freezing motion. The duration of a flash pulse can be set in milliseconds, making it much faster than a mechanical shutter. Since the light pulses are so brief, exceeding the highest shutter speeds of most cameras, the field is often called high-speed photography. There are a few basic points to keep in mind.

First, the faster the object motion that needs to be stopped, the briefer the flash of light needed to freeze it. Ordinary subjects, such as people and slow-moving cars, can easily be frozen by the pulse of light from a regular flash unit. For this reason, portraits and similar shots always look sharper when taken with flash. However, really fast-moving objects such as water drops, hummingbirds, and bullets need extremely brief light pulses.

15.24 Even captive and trained animals move around unpredictably, such as this great grey owl (*Strix nebulosa*) at the Birds of Prey Centre, Old Warden Park, England. A wireless 580EX and reflector held camera right was perfect for freezing the motion of the owl as it looked around.

Second, AC powered studio gear is usually not the best option for freezing motion. Most studio units control the brightness of light output by changing the *amount of power* discharged through the tube. They often have long

"tails" as light output drops off. In contrast, battery-powered flash units control overall light output by altering the *duration* of the flash pulse. A full power pulse from a Speedlite-type unit is actually not all that brief—values of 1/700 sec to 1/1000 sec are typical. But at low power settings, the light produced by battery units is extremely brief, since power to the tube is cut off very rapidly. Therefore, high-speed photography is best performed with ordinary battery flash units at low power settings, or studio units designed specifically for motion-freezing purposes. If the light from one unit is insufficient, then multiple units can be set up to fire simultaneously. Note also that many flash units will extend the duration if power is low, and the fastest flash bursts will be from fully charged units.



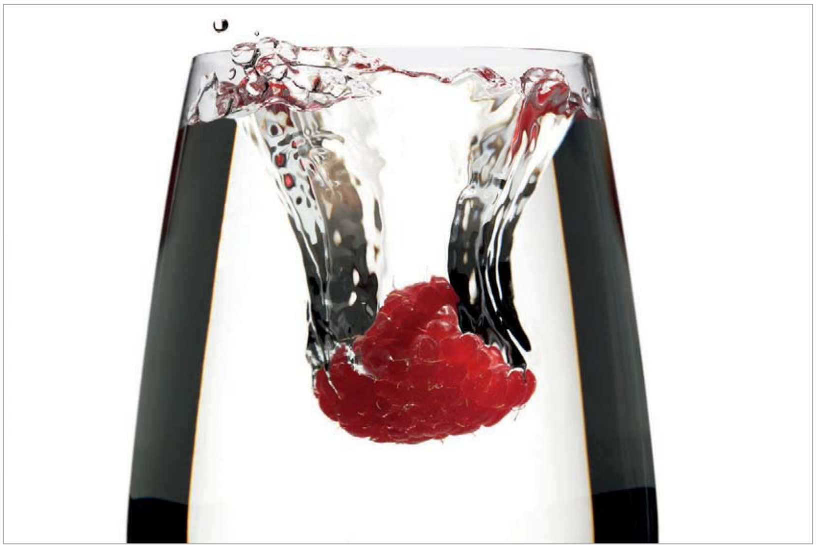
15.25 The world in a drop of water. The tiny liquid droplets act as lenses, showing the photo of Earth that was taped to the wall behind the container of water. Triggered using a StopShot timer (page 345).

15.26 (Opposite page)
A studio flash unit was used to backlight the falling paper moths, but the pulse of light wasn't brief enough to freeze them completely. This was actually intentional, since the blurred edges of the ethereal moths help convey a timeless fairy tale feeling. A story of a woman and her granddaughter lost in some mysterious place, their way guided by some magical moths. Or something.

The interior of the lantern was lit by a 430EX III RT in radio slave mode. An orange gel, a cylinder of paper, and some bubblewrap plastic simulated a candle. At camera left, a studio flash unit,with a blue-gelled gridded dish was used for foreground fill.

A blue-gelled studio flash unit on a tall light stand was used to simulate moonlight and outline the models' hair and shoulders. Barn doors were used to prevent spill onto the black backdrop paper.

Finally, moths cut from vellum paper were shaken down from a tray above and behind the models.



15.27 This shot from the cover of the first edition of this book was taken without any specialized equipment. I set up a 580EX II behind a translucent screen and a 420EX to camera right. I then dropped raspberries into a water-filled wine glass, firing a manual shutter release over and over. It took quite a few attempts to get the timing right, since the flash has to sync to an event (the splash in this case) and not to the shutter opening.

Manual timing is pretty tedious work, so a flash trigger timer is highly recommended for high-speed photography. These electronic devices can fire a flash after a beam of light is broken (a falling water drop, say) or after a microphone hears a sound (perhaps a balloon popping). Variable time delays can then be set so that the flash fires at the perfect moment to capture the action.

15.28 The complex curl of smoke from a stick of incense, frozen by a burst of flash from a 580EX II.

Many people build their own high-speed triggers, so this has become a popular photographic hobby. However, people low on electronic skills or time can also purchase advanced computerized flash triggers such as the ones shown opposite. ☐ 15.29

The left-hand device is the deceptively simple looking Universal Photo Timer from UniversalTimer.com. While compact and equipped with a simple LED display, it has five basic functions.

It can perform time lapse photography and other timed work as an infrared remote; it can trigger cameras and flash units in response to external events such as water drops and the like; it can work as an optical slave for a flash unit; it can perform stroboscopic flash; and it can operate as a remote shutter release. It has two sockets for controlling two separate flash units.

The right-hand device, the StopShot timer from Cognisys, has an advanced LCD screen with control over three separate output devices plus timing and intervalometer options. It supports conditional triggers for crossed beams (e.g., a flying insect will only trigger a shot if two beams are broken, not just one) and can memorize preset configurations. The maker also sells a variety of input devices, such as laser sensors.

15.29

15.30 This image of a light bulb hitting a piece of polished black slate was taken using a Universal Photo Timer.
The timer's built-in microphone was used as the trigger, and a few millisecond delay was required. Two 550EX flash units, one to either side of the bulb, were fired at 1/128 power to immortalize the bulb's demise.

15.10 Cross-polarizing

A common photographic problem is taking a photo of something made of reflective material, such as an oil painting or anything under a sheet of glass. Art documentation has to deal with this problem on a regular basis. The usual suggestion is to put a polarizing filter on the lens. This helps, but any reflected light sources still appear in the photo. A solution? Cross-polarizing.

Cross-polarizing involves putting a sheet of polarizing plastic over a light source, such as a flash unit, as well as placing a polarizing filter over the lens. The lens filter is then rotated so that it's aligned at 90° to the material on the light. When a photo is taken, non-polarized light will record as usual, but polarized light such as direct reflections will almost completely vanish.

15.31

15.32

This work by street artist SNUB23 demonstrates the technique. Since the art was made using glossy enamel spray paint, it was very difficult to photograph without getting rogue hotspots and reflections. Additionally, the art was located in a narrow stairwell, which limited lighting choices considerably. The photo to the left has a very objectionable hotspot. The photo to the right was taken from the same position with the same lighting, but with a polarizer placed over the lens and a sheet of polarizing plastic over the flash head. The polarizer was rotated until the hotspot vanished.

This technique is also useful for nature, wildlife, and food photographers who photograph wet or moist surfaces such as the eye of a fish or a sliced piece of fruit. It can also reveal interesting structures in minerals or reflective surfaces.

15.33 Eye of a rainbow trout, shot normally (left) and cross-polarized (right).

Incidentally, cross-polarizing can also reveal stress lines within transparent plastic objects made using injection molding. The normally transparent items suddenly burst forth into a rainbow of stress patterns. (Though to be honest, the easiest and cheapest way to photograph these patterns is to put a clear object in front of a polarized light source, such as ordinary LCD monitor, and put a polarizer on the lens.) 15.34

15.34

15.11 Learning from the masters

There is much to be learned by studying the works of great painters. They only had oils and canvas rather than CMOS image sensors and xenon flash tubes, but they sure knew a thing or two about light. One painter whose techniques are of great value to portrait photographers is Rembrandt van Rijn.

Many of Rembrandt's paintings are lit predominantly from one side. This effect can be reproduced photographically by positioning a key light to one side of the subject, fairly high up. The other side is filled in by either a lower powered light or a reflector. The result is a simple and elegant portrait, with the shadows providing a dimensionality to the face. A key hallmark of the Rembrandt technique is that the side of the face in shadow typically has a downwards-pointing triangle of light on the cheek, under the eye.

While the formula doesn't have to be strictly followed to work, it can be a useful starting point for basic portrait photography, as shown here.

15.35

15.36

15.37 Musician, producer, and entrepreneur Thomas Dolby.

Bamboo. Sagano bamboo forest. Kyoto, Japan. Sometimes flash can be used to very subtle effect. This photo uses predominantly ambient lighting, but a 580EX II was fired at full power to lighten the color of the nearest bamboo trees, providing a little more depth to the scene. 0.6 sec at *f*/11, ISO 100, 17 mm.

Conclusion

Though this book is arguably one of the most comprehensive books published to date on the subject of flash photography, even at more than 400 pages, it barely scratches the surface. Lighting with flash offers tremendous creative and practical solutions, from the affordability and flexibility of off-camera hotshoe flash to the dizzying choices and budget-straining options of professional studio gear. And the fundamental principles of flash technique can be applied across all forms of short-duration photographic lighting: an expensive studio box really isn't that much harder to use than a small Speedlite.

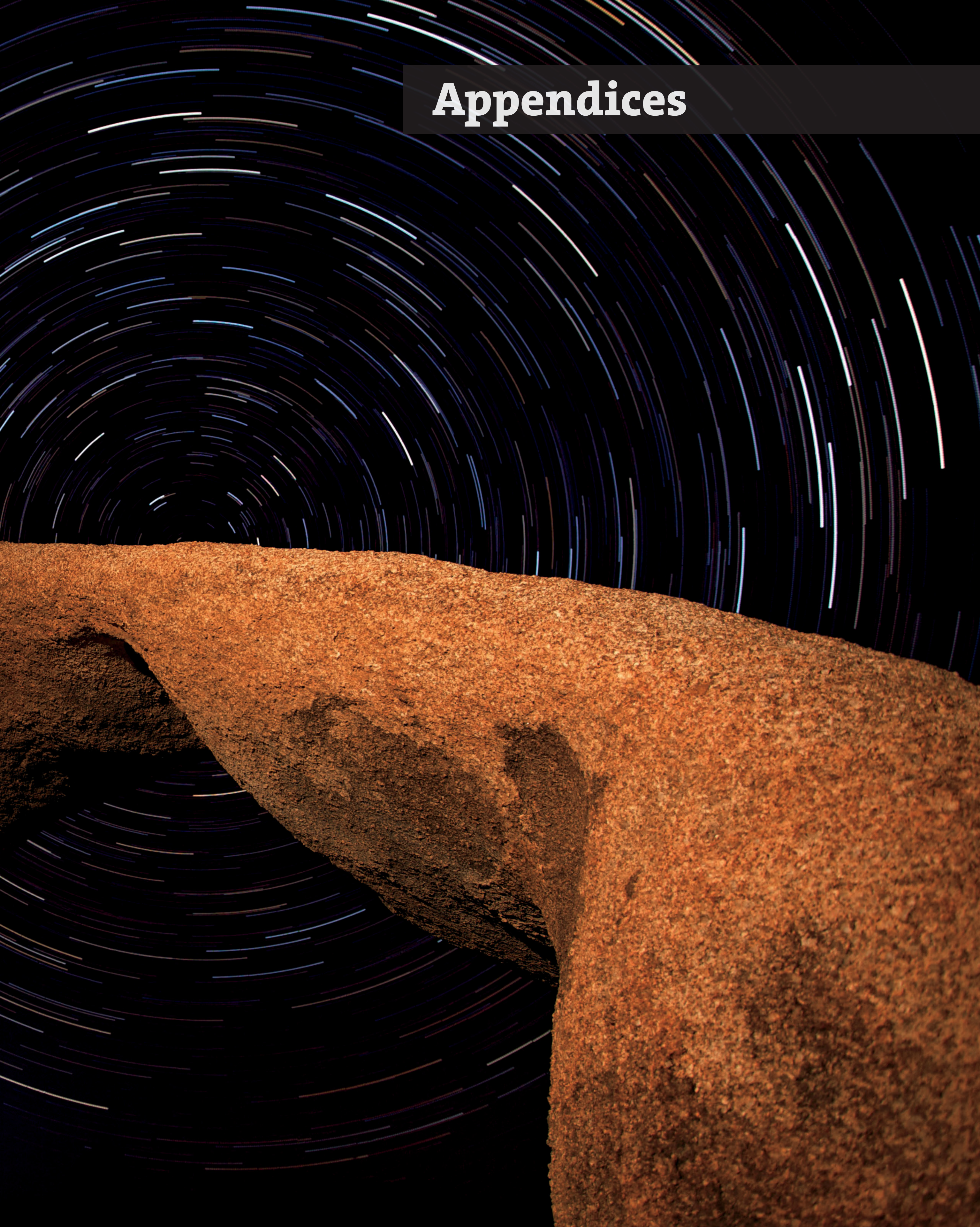
The book is frozen in time to when it was written, but who knows what technological innovations the future will bring? Since the last edition in 2010, we've already seen Canon introduce flash units with integrated radio controllers that provide full metering support. Maybe one day we'll see infinitely variable on-demand color filters using transparent LCDs, tighter preflash timing to reduce blinking eyes, flash output zone control using a touch-screen interface on the camera LCD, and true continuous modeling lights employing high intensity white LEDs. Perhaps someday high efficiency LEDs will supplant xenon tubes altogether.

Whatever technical advances may come, the basic principles of using bright flashes of light to capture still photos will doubtless continue. And hopefully, this book has set some useful starting points for exploring creative lighting solutions. Have fun!

NK Guy
London, England
February 2016

Star Trails over Mobius Arch. This rock formation is sometimes referred to as Galen's Arch in honor of late mountaineer and nature photographer Galen Rowell. Alabama Hills, Owens Valley, California, USA. The picture was taken over a one-hour period, facing north so that the Earth's rotation would be recorded as trails of stars appearing to turn around Polaris. Exposure was allowed to continue until shortly before moonrise so that the gradual lightening of the sky would reveal the distant rocks and hills as a silhouette. While the shot could have been done as a single exposure, this particular image consists of about 80 individual 45-second exposures, taken using an interval timer and stacked together digitally to keep noise to a minimum. During the last exposure, a single half power burst of flash from a 580EX II, equipped with a 1/2 CTO filter, was fired by hand. This illuminated the arch, which would otherwise have been completely black. EOS 5D Mark II, 80x 45 sec at *f*/4, ISO 200, 17mm.

Appendices



Appendix A: Flash Units for Canon EOS

Speedlites for film and digital cameras (E-TTL)

These flash units are compatible with all Canon EOS type A cameras that support E-TTL and E-TTL II metering. Some can revert to legacy TTL mode for film cameras. However, the 90EX, 270EX, 270EX II, 320EX, 430EX III, and 430EX III-RT are E-TTL only.

Speedlite 90EX

This miniature unit seems like a fairly useless add-on for the tiny EOS M series of mirrorless cameras. It's powered by twin AAA cells, giving it a very ponderous recycle time. But it has a trick up its sleeve—it can serve as an optical wireless E-TTL master, making it a portable and affordable solution for wireless flash, albeit one with limited range. Canon should have marketed this one as a Speedlite Transmitter.

It's almost devoid of physical buttons, and requires ESC menu control. It has no red AF assist light. When in optical wireless master mode it won't provide any scene-illuminating light. E-TTL only.

17.1 220EX

Speedlite 220EX

The E-TTL successor to the Speedlite 200E has slightly greater range and a few E-TTL functions. It's a very small unit for cameras that lack built-in flash. It can neither tilt nor swivel, nor serve as a wireless E-TTL slave. Fixed 28 mm coverage, and the red AF assist light covers the center point only. Discontinued.

17.2 270EX

Speedlite 270EX

The 220EX's replacement has a tilting head and a two-position hand-operated zoom. Unfortunately, it lacks a red AF assist light and instead pulses its main tube annoyingly in low light conditions. It uses only two AA batteries, so it's quite compact but recycles slowly.

Lacking the usual physical controls, most of the 270EX's features are only available on cameras that have Speedlite menu control (ESC). E-TTL only. Discontinued.

Speedlite 270EX II

The 270EX II adds a significant new feature—optical wireless slave mode, though group A only. This makes the 270EX II the perfect partner for the 90EX for the casual photographer—you simply carry a 90EX and one or two 270EX II's, and you've got a lightweight low-power multi-flash setup. The 270EX II has a side-mounted button that lets the unit emit the same IR commands as a Canon RC-1, RC-5, or RC-6 controller, so you can use the flash unit as a remote controller and take photos without walking back to the camera.

Speedlite 320EX

Unlike its smaller brethren, the 320EX is powered by four AA batteries and has physical controls for optical wireless slave mode. It also works with a camera's ESC menu control. Its head can be swiveled and rotated, but its zoom is limited: its head can be manually extended to a second position for use with longer lenses. It has a white LED, which can serve as an autofocus light if the camera is in Live View mode, or it can be used as a modest light source for video. Finally, it has an RC-1/5/6 compatible remote control like the 270EX II.

17.3 380EX

Speedlite 380EX

An early EX flash unit, the 380EX has three significant drawbacks. First, while it can tilt its zoomable head, it can't swivel. Second, it can't use wireless E-TTL. Third, it has no flash exposure compensation for cameras that lack FEC.

Other than those limitations, it's a mid-sized flash unit with the usual E-TTL abilities. Its red AF assist light covers the central point only. It has no manual controls of any kind. Discontinued.

17.4 420EX

Speedlite 420EX

The first affordable EX unit with optical wireless slave capabilities. The 420EX lacks a screen or manual control but can zoom, tilt, and swivel and supports most E-TTL functions. Its red AF assist light covers seven focus points, and it has modeling light support. It lacks on-board controls for flash exposure compensation. Can be confused with the older 420EZ.

No manual controls for either flash output or zoom. Discontinued.

Speedlite 430EX

A definite upgrade to the 420EX with an LCD, manual controls (output, zoom, and curtain sync), a pull-out diffuser panel, single-button tilt and swivel, and custom functions. In addition to optical wireless slave functions, it has digital features such as sensor size compensation.

Compared to the 580EX, it lacks optical wireless master capabilities, stroboscopic operation, weatherproofing, battery pack socket, and has lower output. Its red AF assist covers up to nine focus points. Can be confused with the older 430EZ. Full manual controls. Discontinued.

Speedlite 430EX II

The 430EX II adds a metal foot with quick-release lock and compatibility with camera menus. It's quieter and a bit faster at recycling. Its main drawback is that engaging optical E-TTL slave mode requires time-consuming menu button presses, rather than the simple switch on the 420EX or 430EX.

A good product, but optical E-TTL slave only. Full manual controls. Discontinued.

17.5 430EX

17.6 430EX II

Speedlite 430EX III-RT

The 430EX III-RT boasts radio compatibility, and is the first midrange Canon flash unit to support master control (though only in radio mode—it can act solely as an optical slave). A dot-matrix display with an easy-to-use menu interface controlled by a dial (superior to the 600EX-RT system, in my opinion), compact and portable, full manual options.

It's basically an excellent product, lacking only certain pro features such as a battery pack socket. The non-radio 430EX III is available in a handful of markets.

Speedlite 550EX

The 550EX was the first flagship of the E-TTL era. It introduced optical wireless E-TTL control, and it can serve as a master or a slave unit. It's the largest and heaviest of all the 500 series flash units, and has full manual controls and and stroboscopic output. No custom functions.

Bulky, is noisy in operation, and its buttons are recessed and awkward to operate. Discontinued.

17.7 550EX

17.8 580EX

17.9 580EX II

Speedlite 580EX

The most compact of the 500 series units, the 580EX also introduces an improved interface with easier to operate buttons, custom functions, and a dial configuration. It's a nice upgrade from the chunky 550EX. Like its predecessor, it has a quick and easy physical switch for engaging optical wireless master and slave modes, making it a popular buy on the used market. Full manual controls.

It has an old-style rotating wheel foot, and is not ESC compatible. Discontinued.

Speedlite 580EX II

The 580EX II adds weatherproofing, a quick-release foot design, menu control from compatible cameras (ESC), single-button tilt and swivel, and silent recycling. It's slightly larger than the 580EX. Full manual controls and a PC socket.

Unfortunately, engaging its optical wireless mode requires fiddly and time-consuming button holds rather than the simple switch found on its predecessors. Discontinued.

Speedlite 600EX-RT

The current top dog in the lineup, the 600EX-RT has all the features of its flagship predecessors, with the game-changing addition of truly solid radio wireless. Other new features include a dot-matrix LCD screen, a "self-cleaning" foot design, an optional filter holder with automatic recognition of two CTO filter types, optional remote camera control, a beeper, and a good wireless interface. Despite having all these features, it's still backwards compatible with optical wireless E-TTL and even with film-era TTL metering.

It has almost the same light output as its predecessors—it just has a longer zoom reach. Many of the more desirable radio wireless features, such as 5-group support and high-speed sync, don't work with older cameras that aren't radio aware. The non-radio 600EX is available in a handful of markets.

17.10 ST-E2

Speedlite Transmitter ST-E2

A compact master unit for optical wireless E-TTL. Cannot produce scene-illuminating light. Can control slave units in small rooms, but severely hobbled by weak range and its inability to control units in group C. It has a red assist light for low-light AF. Uses a lithium 2CR5 battery.

Speedlite Transmitter ST-E3-RT

The ST-E3-RT is the radio wireless E-TTL successor to the ST-E2. Like its ancestor, it can't produce any scene-illuminating light, but unlike the ST-E2, the ST-E3-RT has full control over all radio wireless features. This includes manual flash, 5-group control, remote shutter release, and so on. Unlike the 600EX-RT, the Speedlite Transmitter does not support optical wireless E-TTL and sadly lacks a red AF assist light. It runs off two AA cells and has a dot-matrix display.

Macro flash

There are four Speedlites designed specifically for macro (closeup) photography.

17.11 ML-3

Speedlite ML-3 Ring Lite

This film-only macro unit comes in two pieces joined by a detachable cable. The body fits on the hotshoe, and the head fits around the end of a lens. The two tubes are curved but do not cover a full 180°. Because of the modeling lights, each tube has an arc of roughly 150°. It fits directly onto Canon 50 mm 2.5, 100 mm 2.8 macro, 100 mm 2.8 USM macro, and MP-E 65 mm lenses. An adapter ring is needed for the 180 mm 3.5L macro. It does not fasten onto the filter threads, and so is not directly compatible with third-party macro lenses or other non-macro lenses.

Unfortunately, the ML-3 is only useful for film camera (TTL) users. No manual controls, and therefore of very limited value today. No way of adjusting the ratio between the two tubes. Discontinued.

17.12 MR-14EX

Speedlite MR-14EX Ring Lite

Similar to the ML-3, but updated for E-TTL. Non-detachable cable between control unit and head. Vastly more advanced in terms of controls, with a control panel and display similar to the 550EX. Like the 550EX, it has awkwardly recessed buttons, and like the ML-3, it has true curved flash tubes covering about 150° each.

In addition to support for E-TTL metering, it supports high-speed sync, stroboscopic output, and full manual control. It supports A:B ratios between

the two tubes and can also support a slave unit in group C for background lighting. Discontinued.

Speedlite MR-14EX II Ring Lite

The mark II version is a light update, including a dot-matrix display. It adds the new-style dial and contextual button interface, silent recycling and personal functions, increases the number of steps for manual flash mode, and replaces the white light bulbs with energy-saving LEDs. Despite its appearance, however, it doesn't support radio wireless E-TTL; just old-style optical where the left and right tubes are in groups A and B respectively.

Speedlite MT-24EX Macro Lite

Similar body/control unit as the MR-14EX, but consists of two separate and detachable flash heads instead of a ring. Each head can clip onto a rotating ring that fits Canon's standard macro lens lineup. The heads can move and tilt, and put out a bit more power than the MR-14EX.

Whereas ringlights create very flat macro lighting, the MT-24EX allows for a slightly more sculpted look by making it easier to cast shadows across the subject. Very expensive.

17.13 MT-24EX

Speedlites for film cameras (TTL)

The flash units in this section are all discontinued. They're obsolete TTL-only devices,which cannot meter with digital bodies. In TTL mode, flash units will fire at full power on some digital bodies and won't fire at all on others. Manual-capable devices can still be used if automatic metering isn't required, of course.

17.14 160E

Speedlite 160E

A tiny add-on for EOS film cameras that lack built-in flash. It's absolutely minimalist and has an autofocus assist light, a two-color flash ready ("pilot") light, and nothing else. It has no power switch, powers up when you half-press the shutter, and misfires on some digital models. No manual controls.

Speedlite 200E

The 160E's successor. Slightly larger, slightly more powerful, the 200E uses 4 AAs and has a power switch and a locking foot. TTL only with fixed coverage, though an optional clip-on plastic panel takes the coverage to 28 mm. No manual controls.

17.15 200E

17.16 200M

17.17 300EZ

17.18 300TL

Speedlite 200M

This flash unit was made uniquely for the film-based Canon EF-M, which was an EOS Rebel/1000 with autofocus, TTL flash metering, and the top deck LCD removed.

The Speedlite 200M was a 200E with TTL functionality removed and a simple autoflash sensor added. No manual controls.

Speedlite 300EZ

One of the least useful early Speedlites, the 300EZ supports TTL and A-TTL. Oddly, the only switch on the back, aside from power, sets first or second curtain sync. Despite its size, its head will neither tilt nor swivel, restricting it to direct flash only. No manual controls.

Speedlite 300TL

This flash unit doesn't really belong here, since it was made for the Canon T90, the manual-focus predecessor to the EOS system. However, the 300TL is compatible with EOS film bodies in basic TTL mode. Certain advanced features work only with the T90, such as FE lock and second curtain sync.

In manual mode it only has two output levels—low and high. Its zoom head must be moved by hand. Tilt and swivel capabilities.

17.19 420EZ

Speedlite 420EZ

The first high end tilt/swivel flash unit in the EOS lineup, the 420EZ is of limited value today. It lacks flash exposure compensation controls and has no high voltage socket. Supports A-TTL in P, Av, and Tv modes, though in bounce mode the 420EZ fires annoying light flashes when the shutter release is pressed halfway.

The 430EZ or 540EZ are better choices for EOS film users. The 420EZ is mainly useful today for someone looking for a cheap unit with manual flash controls and stroboscopic output of up to 5 Hz (pulses per second).

Speedlite 430EZ

FEC buttons, improved LCD, and a socket for a high-voltage pack. The stroboscopic function has a maximum of 10 Hz. Supports A-TTL in P, Av, and Tv modes, though in A-TTL bounce mode, the 430EZ fires annoying light when the shutter release is pressed halfway. The model for the USA, Liberia, and Burma is in feet and the model for everywhere else is in meters.

The 430EZ is available quite inexpensively and is a reasonable flash unit for all-manual operation.

17.20 430EZ

Speedlite 480EG

Sometimes jokingly referred to as a "hammerhead" or "potato masher," the 480EG was Canon's only grip-style flash unit for EOS: heavy and powerful with a built-in bracket. It reaches GN 48 via two flash tubes with a fixed 35mm coverage.

The unit has TTL for film cameras, a basic form of manual control (full, 1/4, and 1/16 power only), and autoflash.

It requires a Transistor Pack E. Works with Canon compact battery packs, but with slower cycle times and lower output. Also requires either the Shoe Cord E, which attaches to a hotshoe and provides TTL, or the Synchro Cord 480 that connects to a camera's PC socket for autoflash or manual. Both cords are very difficult to find. An ordinary PC cable can be used for manual operation.

Other accessories: Panel Adapter 480 with Wide (28 mm coverage) and Tele (135 mm coverage and a GN of 68) panels and the Slave Unit E.

17.21 480EG

Speedlite 540EZ

The pinnacle of TTL flash technology, the 540EZ also supports A-TTL, though only in P mode direct. Does not fire visible light pulses in bounce mode. Flip-out diffuser panel and support for up to 100 Hz in stroboscopic mode.

Fairly bulky and quite noisy in operation, since its multiplexing circuitry produces a whine. Buttons are recessed and awkward to operate. A good manual-only flash unit, though there is no sync socket.

17.22 540EZ

Third-party flash

As discussed in the section on dedicated flash, a number of companies have produced flash units that are compatible with Canon EOS cameras. None are officially sanctioned by Canon, so they're built by reverse-engineering the Canon control language for flash. This means there is no guarantee of compatibility, though units by well-known makers are reasonably reliable.

The following products were examined and tested for inclusion in this book. It's not an exhaustive list by any means. Some makers, notably Sunpak

and Metz, did not participate, though a Metz distributor did provide some non-system units.

Sigma

Sigma of Japan is best known for its extensive lineup of lenses, which are made to fit all the popular Japanese SLR systems. The firm also produces a few flash units. Be sure to look for "EO E-TTL II", indicating EOS compatibility.

The Sigma products compete mainly on cost. Many older Sigma flash units, other than the EF-530 DG ST and Super units, are not compatible with Canon EOS digital cameras.

Sigma EF-610 DG ST

This unit is functionally analogous to the ancient Speedlite 380EX, though with significantly greater power output. However, important features are missing: there are no second curtain sync, wireless E-TTL, high-speed sync flash, rear-panel LCD, or AF assist light coverage beyond the central point.

It has manual controls, but they're not useful since the unit can fire either at full power or 1/16 power only, and the unit will not fire if the center pin alone is grounded (i.e., it's not compatible with sync-only triggering devices). In short, it has few benefits over a used EX series Speedlite.

17.23 EF-610 DG ST

Sigma EF-610 DG Super

While the same size and shape as the EF-610 DG ST, the similarly named Super is more advanced, offering most of the functionality of 1998's Canon Speedlite 550EX. It offers good output, has a flexible zooming/tilting/rotating flash head, supports advanced features such as second curtain sync and stroboscopic flash, has full manual output control, and is compatible with optical wireless E-TTL both as a master and a slave (though confusingly refers to groups A, B, and C as 1, 2, and 3). It also has a built-in optical slave, a feature no modern Speedlite has, and so can work as a "dumb" manual slave with sync-only flash triggers.

Its primary drawbacks are no radio E-TTL support, lightweight build quality, an AF assist light that only covers the center focus point, longer recycle time, no custom functions, no high voltage port, and a difficult to navigate menu system. It also has annoying problems such as a high-speed sync (FP) mode that goes off whenever the shutter speed drops below X-sync, and a fiddly battery door. It also lacks newer features such as ESC compatibility.

If the limitations above—particularly the lack of E-TTL radio support—don't dissuade you, and if the manual is in your camera bag for when you need to figure out how to use it, the EF-610 DG Super is okay. However, its design is long in the tooth and in need of an update.

17.24 EF-610 DG Super

Sigma EM-140 DG

A macro flash unit resembling the Canon Speedlite MR-14EX. The body is basically the same as the Sigma EF-610 DG Super, and the tubes are mounted in a ring-shaped casing. However, unlike the MR-14EX, the tubes are not curved and so it's more a double-headed macro flash than a true ring light. It fastens onto the filter threads of a lens and ships with 55 mm and 58 mm adapter rings. Additionally, 62, 72, and 77 mm rings are available. It has a pair of white incandescent bulbs for focus assist, and modeling lighting via pulsed output of the main tubes is also possible.

Controls are almost identical to the EF-610 DG Super and similarly awkward to use. However, a wide range of features is supported, including tube ratios, second curtain, stroboscopic flash, manual output control, and wireless E-TTL control of a slave in group C. The same issues with the EF-610 DG Super apply to this model.

17.25 EM-140 DG

Metz

Metz, a respected German flash manufacturer, produces four categories of flash units that work with Canon EOS, all sold under the "Mecablitz" product name ("Blitz" is German for "lightning" or "flash").

1. "System flash" units are those models dedicated to a specific camera manufacturer. Thus, a system flash such as the Mecablitz 64 AF-1 that works with Canon EOS cameras will not work with Nikon cameras. At time of writing, there are six Metz flash units dedicated to Canon EOS.
2. Older "SCA" units are not dedicated to any one-camera system. Instead, add-on adapters must be installed between an SCA flash unit and the camera. These SCA adapters, which support various forms of automated metering, can be exchanged and replaced as necessary. Metz appears to be moving away from this model.
3. "Automatic" units are autoflash-only models. These units have built-in photocells for autoflash metering and do not support any form of camera-controlled TTL automatic metering. They work with any camera.
4. "Slave" units are small portable units that are designed to be triggered by a master flash unit or an on-camera flash.

The Metz range is much more extensive than Canon's, and Metz offers features that Canon units do not—such as flash units with touch LCDs, built-in secondary flash tubes, and USB ports for upgrades. Note that some of the terms used in Metz's advertising and documentation have been translated from German and differ from Canon's terminology. Metz's "lighting control indicator" is what Canon calls a "flash exposure confirmation" light, for example. An "AF measuring beam" is the confusing name for an "AF assist light" or "AF auxiliary light."

17.26 15 MS-1 macro slave flash

Mecablitz 15 MS-1 macro slave flash

The 15 MS-1 is a unique and innovative product. It's a tiny ring-shaped macro unit that's automatic and self-powered by two AAA cells (i.e., it doesn't have a separate control box). It can be controlled by a variety of optical wireless masters, including Canon E-TTL masters, and is ideal for cameras with Speedlite control via built-in flash.

A black plastic ring in shape, it fits around the end of most ordinary camera lenses, fastening to the filter threads. Note that although the device is ring-shaped, its tubes aren't. The flash tubes are short straight tubes located 180° across from each other and do not curve around the lens like a true ring flash.

Without a master unit, the 15 MS-1 functions in manual mode only. It has learning capabilities and can be taught to ignore the metering preflashes used by E-TTL, allowing it to sync correctly with an E-TTL flash unit such as the built-in flash on EOS digital cameras. However, its power output must then be set by hand.

17.27 76 MZ-5 hammerhead

Mecablitz 76 MZ-5 hammerhead

This flash unit is a large and heavy grip design, favored by press and wedding photographers. Its chief benefit is that it's capable of producing a tremendous amount of light: its guide number at 105 mm is 76. It can speak E-TTL through the add-on SCA 3002 adapter, though it also supports manual control and autoflash.

One interesting feature is its secondary flash tube, somewhat misleadingly referred to as a second "reflector." This is a tube on the handle that is independent of the main flash tube. If the flash head is tilted up for bounce lighting, this small secondary tube can provide some frontal fill flash.

Yongnuo

17.28 YN600EX-RT

Yongnuo YN600EX-RT

The YN600EX-RT is a surprisingly complete clone of Canon's Speedlite 600EX-RT. In the past, copied products tended to be shoddily built and devoid of features, but this is an example of a new generation of clones. It supports virtually all of Canon's features, is compatible with the RT radio protocol, is almost identical in physical size and appearance, and costs significantly less than its Canon counterpart. If you're trying to set up a multiple-flash kit on a budget, then buying a set of these clones will save considerable cash.

However, the product isn't perfect. In my testing I found that the rear dial would frequently skip, the autofocus assist LED didn't line up with my camera's autofocus points, the battery door mechanism is weak, it overheats rapidly, and most aggravating, the device would drain its batteries

in a couple of days when in storage. These general reliability issues don't afflict the Canon unit.

Yongnuo YN-E3-RT

Another clone device, this time a nearly identical copy of the Speedlite Transmitter ST-E3-RT. It serves as a Canon E-TTL radio wireless master, and offers the same feature set. Interestingly, it has a red autofocus assist LED, which its Canon counterpart lacks: unfortunately, it covers only a camera's central AF point. My test unit also suffered from the same battery drain problem as the YN600EX-RT.

17.29 YN-E3-RT

Yongnuo YNE3-RX

This is a very interesting product that goes beyond merely copying Canon's products. The YNE3-RX is a small radio receiver that attaches to older E-TTL compatible flash units and gives them Canon RT radio compatibility. You can now take your trusty old 580EX, say, and use it in a basic Canon RT environment.

The device has a simple on/off slide switch, and three buttons used to change the device's ID, group, channel, and manual power settings. It works fairly well, but its Achilles heel is a terrible foot design, which, despite being made of sturdy metal, lacks a locking mechanism. Flash units thus easily fall off.

17.30 Yongnuo YNE3-RX

Quantum

Quantum Instruments is the U.S. manufacturer of an unusual line of flash units. The Qflash products can be described as either large, battery-powered units or small studio units, depending on your point of view. Either way, they bridge the gap between sophisticated, computerized, but low-power Speedlites and technically simpler but higher-power studio units. They also produce a dizzying array of accessories, adapters, and interfaces to allow their Qflash units to work with cameras from Canon and other makers.

The basis of the Quantum line is the Qflash series. The main units at time of writing are the T5d-R and X5d-R units, which are both high-power units with parabolic reflectors rather than zooming heads like a Speedlite. The units alone are a bit bigger than a Speedlite, not including the large and bulky battery pack that's required to power them. Qflash units are designed for portable applications and do not plug into AC sockets.

Qflash units can be fired sync-only via cables or Quantum's FreeXwire radio system, or they can connect directly to a Canon camera via a special E-TTL hotshoe adapter. These adapters permit the transmission of radio signals compatible with Canon preflash E-TTL metering. Additional adapters, the QNexus line, allow Qflash units to serve as wireless E-TTL slaves.

17.31 Quantum Qflash T5d-R

17.32 A Quantum Qflash equipped with a collapsible softbox, FreeXwire radio receiver, and Quantum Turbo battery pack.

The company also makes a shoe mount flash unit: the Qflash Trio. This is a dedicated hotshoe unit of similar size and shape to the rest of the Qflash line. It supports regular E-TTL metering and contains a built-in, Quantum-compatible radio transmitter. Unlike a Canon Speedlite, the Trio requires an external battery pack.

Quantum products are popular with wedding photographers and others who require large amounts of portable light for location shoots. Another advantage for wedding and sports photographers is that the Qflash units recycle very quickly, thanks to their external Turbo battery packs. The principal drawbacks of the product line are the cost and the confusing range of different adapters and accessories.

Nissin

Nissin Digital (no relation to Nissin, the cup noodle manufacturer or Nissan, the car company) produces a number of hotshoe flash units, all of which are available as Canon-only models and Nikon-only models.

Nissin Di866

The Di866 is quite an unusual third-party flash unit. Most makers of such products generally focus on replicating the name brand's key features at a lower price, but the Di866 introduces a number of new features not found elsewhere in a hotshoe flash unit powered by four AAs.

The Di866 is roughly analogous to the 550EX in terms of its basic functionality, though it doesn't offer the exact set of features as the Canon unit. Standard features include E-TTL/E-TTL II compatibility, a swivel/tilt/zoom head, a retractable wide-angle diffuser and bounce card, stroboscopic flash, wireless master/slave, and a high-voltage socket for a Nissin-proprietary battery pack.

17.33 Di866

Unusual features include a secondary fill flash tube, a color display on the back with a menu system, rotation detection, a removable battery magazine, a USB port, and a guide number of 60 (meters, ISO 100) at 105 mm. It also produces strange intermittent beeping noises while idling, as though it is communicating with the mothership, and sports an uncomfortably bright pilot LED. This latter feature is a real nuisance when using the unit on-camera in low light conditions, as the LED is positioned right by the viewfinder.

17.34 Di866 LCD

The secondary front-mounted tube, like those found on some Metz units, allows for a tiny bit of frontal fill flash at GN 12 when the main flash head is in bounce mode. The output of this "sub" flash is set manually through a hidden menu option. The color display allows for an icon-driven graphical user interface, and rotation detection allows the screen to rotate when the camera is turned to portrait mode. The 4xAA battery magazine, like those found in old Vivitar units, allows for rapid pack changes in the field. There

is a USB port for downloadable upgrades from the Internet, if the company releases any. And the high GN is primarily there for bragging rights, since it's not much higher than a 580EX or a Nikon SB900.

In short, it's not a replacement for Speedlite 500 series units, as certain pro features are incomplete or missing. However, it's a sturdy-feeling basic flash that also pioneers some clever and innovative functions.

Generic flash units

Be extremely cautious when considering a generic flash that's branded as Canon EOS compatible. Many older, cheap flash units are TTL only, which means they won't work on a Canon EOS digital camera. Some of them are merely simple autoflash units with neither TTL nor E-TTL support, despite their misleading packaging. This is a classic situation of buyer beware, particularly when purchasing something online, sight unseen. This isn't to say that lesser-known brands are necessarily poor quality, just that it's essential to test the products on-camera first.

Some of these lesser-known brand names include Achiever, Bower (not to be confused with Bowens), Carena, Cullmann, Dörr, Dot Line, Emoblitz, FalconEyes, Opteka, Phoenix, Promaster, Quantaray, Rokinon, Sakar, Soligor, Starblitz, Tumax, and Vivitar. Many of these brands are distributors and marketers that resell products made by others under their own nameplates.

All-manual battery flash

The following are some all-manual battery-powered flash units. All operate on four AA cells, have some form of manual control over output power, and lack modern features such as TTL metering or LCD panels. Some also have autoflash capabilities.

So why buy them at all? Quite simply, with digital the possibilities of manual-only flash have become quite accessible. See chapter 11: Off-Camera Flash for details.

Vivitar 285

The Vivitar 285 is a classic flash unit originally released in the early 1970s. The unit shown here is over 20 years old but still works well, using either manual or autoflash metering (section 10.7). These units were rugged workhorses for many years.

The 285, its predecessor 283, and its successor 285HV have limitations—they're quite bulky and noisy, have only four manual output power choices, have a non-standard sync socket, are slow to recharge, and lack an optical slave trigger. The 285 and 285HV have three-position manual zooming heads. Some early models have a very high trigger voltage, in the double digits (see next section).

17.35 Vivitar 285

17.36 LumoPro LP120

17.37 Yongnuo YN460

17.38 Nikon SB-800

Additionally, production of these units took place at various factories around the globe over the years, and the final production runs have a reputation for poor build quality. Vivitar as a separate entity is no longer in business, but Cactus/Gadget Infinity resurrected and rebranded the 285HV as the KF36. Vivitar is now a marketing brand used by accessory company Sakar, which sells cheap camera products under the name.

LumoPro LP120

LumoPro is the house brand for U.S. retailer Midwest Photo Exchange. The LP120 is an all-manual flash stripped down to the basic elements, which is geared toward the off-camera flash user on a budget. It features manual control in six steps to 1/32, two sync ports (a PC socket and a 3.5 mm mini-jack), a built-in optical slave, and a manually zooming head that can bounce and swivel. There's a wide-angle diffuser panel, but it's a clip-on and not integral, making it easy to lose but harder to break.

That's it. No bells, no whistles (literally—it's rather quiet). It's not perfect—the limited number of power steps means a big jump between full and half power; the two-switch power output control is quite bizarre and arranged backwards from what one might expect; the build quality is quite light; and the zooming head only goes to 85 mm—but it's very affordable and straightforward. Modest power: GN 30 at 50 mm, and a bit slow to recycle.

Yongnuo YN460

This is another inexpensive and moderately sized unit designed specifically for the amateur strobist. It's of fairly light build quality, and the user interface consists of a series of rear-panel LEDs. The manual control is basic and easy to read, with a pair of + and – buttons beneath a simple seven-light output scale, from full power to 1/64. No zooming flash head, though it

does have a delicate flip-down diffuser for 18 mm coverage and a small bounce card. Full tilt and swivel. Somewhat noisy when charging or idling.

It has a 30-minute energy-saving timeout, which is not adjustable but is a reasonable length of time. It has a regular optical slave sensor and the ability to ignore preflashes. Unfortunately, the slave sensor is positioned inside the flash head, despite the unused red window on the front. No sync socket, oddly enough.

Nikon Speedlight SB-800

It may seem surprising to mention Nikon products in a book on Canon flash, but over the years, Nikon has produced many high quality battery-powered flash units. While Nikon TTL, D-TTL, and i-TTL automatic metering is, of course, incompatible with Canon cameras, Nikon Speedlights (note the spelling) often have manual controls, making them excellent remote devices for manual flash work. Some Nikon units, such as the SB-800, also have PC sockets (section 11.4) for connecting directly to a camera or remote trigger.

Appendix B: Choosing a Flash Unit

Choosing the right flash unit for a job depends on a host of factors. There is no one perfect flash unit for all purposes.

Before shopping for a flash unit, consider how it's likely to be used. Is it needed just for occasional snapshots? For heavy use out in the field? For indoor amateur studio work? What about size and weight? After all, a high-end flash unit is bigger than a consumer camera. What budget restrictions are there? Are there any plans to expand to a wireless system, or is a single on-camera flash unit adequate?

Here are a few suggestions for various types of flash usage.

A flash unit for casual and occasional use with a Canon digital camera

Recommended:

- If you plan on using radio wireless (and you should), the 430EX III-RT is a surprisingly capable and full-featured product. If you're on a budget, the earlier 430EX and 430EX II models are fine if you just want a lightweight on-camera unit, but don't foresee moving into radio wireless.
- The pocketable 270EX II is useless as an on-camera unit, but is a fun low-power optical slave, especially if your camera can use its built-in flash unit as a Speedlite master.

Not recommended:

- E and EZ models don't meter with digital cameras. Avoid these!
- The 380EX lacks swivel and wireless slave capabilities. The 420EX lacks manual controls and has no FEC on some consumer bodies.
- The 500/600 EX units are quite large and expensive, and may be overkill for casual use.
- Rock-bottom cheap flash units billed as "Canon compatible" should always be considered with caution. Never buy one without testing it first, as many have compatibility issues.
- Don't buy the 430EX III or 600EX. Go for the RT radio-equipped versions.

Advanced use with a Canon digital camera

Recommended:

- The 600EX-RT is expensive, but can do everything you'd want a flash unit to do, including working with Canon's radio wireless system. If you really want to stick with optical wireless, the 580EX is the most convenient to use.

Not recommended:

- Avoid any flash units that lack wireless controls and manual output, as they place limits on future expansion.

A flash system for wireless E-TTL

One's first inclination might be to buy a 500 series unit as a master and a 400 series as a remote slave. The trouble is, in terms of power output, it makes more sense to have the master provide on-camera fill and the slave provide the main light. I also recommend using radio wireless E-TTL, if your budget can handle it, since optical wireless E-TTL is far less reliable.

Recommended:

- Two 430EX III-RT units, each of which can serve as either master or slave in radio mode. Or a 430EX III-RT master with a 600EX-RT slave. The Yongnuo clone of the 600EX-RT is also surprisingly good if you're on a budget, though it quickly drains batteries.

Not recommended:

- The ST-E2 is fairly useless. Older 5xx series EX units are okay for optical wireless only.

A flash unit for all-manual work, Strobist-style

Here, it all depends on your priorities. Is you goal to use manual flash exclusively, or do you want to build a system that can be used both automatically and manually? Relatively few of Canon's flash units are suited solely for manual work, because they're optimized for automatic use.

Recommended:

- Any battery-powered flash unit from any manufacturer works well, as long as it has manual output controls. However, a built-in sync port, the ability to recycle the unit quickly, and a zooming flash head are very useful features. Canon 500/600 EX units are fine for this, but they are expensive choices, unless they're also being used for their automatic capabilities.

Not recommended:

- A fully automatic flash unit that lacks manual controls is useless.
- A flash unit with auto power-off that can't be overridden, especially if the power-off timer is less than 5 minutes.
- An older unit with high voltages on its flash foot can sometimes damage cameras or wireless triggers.
- Any third-party flash unit that can't fire when the center pin is triggered.

A flash unit for macro photography

While specialized macro units are very handy tools, it's possible to use regular flash units as well. Any flash unit positioned off-camera with a suitable diffuser can serve as a good macro flash unit; it's simply more awkward to use.

Recommended:

- The MR-14EX is good if a ring-type flash unit is needed, though its flat light isn't suitable for all subjects. The MT-24EX is expensive, and its ability to move flash heads independently is valuable for some types of photography but not others.

Not recommended:

- The ML-3 is TTL only and lacks manual controls; useless for digital cameras. The Sigma EM-140 DG is not a true ring flash, and doesn't offer significant enough savings to make it a better choice than the MR-14EX. The MR-14EX II has a nice screen, but is rather expensive for what you get.

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Appendix C: Features Table

	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II
Max guide number, meters	16	20	20	30	30	42	43	48	54	11	9	22	27	27
Max guide number, feet	52	65	65	98	98	137	140	156	176	36	30	72	88	88
• GN at 14mm														
• GN at 17mm or 18mm									16					
• GN at 24mm				25		25	25		28		9			
GN at 28mm					22	27	27		30			22	22	22
GN at 35mm	16	20	20	30	25	30	30	48	36					
GN at 50mm				35	28	35	35		42				27	27
GN at 70mm					30	40	40		46					
GN at 80mm				40		42	43		50					
GN at 105mm									54					
GN at 200mm														
Year introduced	1988	1990	1991	1986	1987	1987	1989	1993	1994	1989	2012	1996	2009	2011
Year discontinued	1990	1996	?	?	1995	1989	1994	?	1998	2001	Current	2009	2011	Current
Physical														
• Width/height/depth in mm	59×83×52	64×104×41	64×104×41	81×119×94	66×89×100	75×122×106	75×122×106	98×257×114	80×138×112	74×61×107	44×52×65	65×92×61	64×65×73	64×65×73
• Ring/heads width/height/depth										106×123×25				
• Weight without batteries	85g	130g	130g	395g	215g	365g	365g	715g	415g	365g	50g	160g	145g	145g
• Foot material	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Metal	Metal
• Foot lock type	No lock	Slide lock	Slide lock	Wheel	Wheel	Wheel	Wheel, pin	None	Wheel, pin		Slide lock, pin	Slide lock, pin	Slide lock, pin	Slide lock, pin
• Self-cleaning foot														
• Weatherproofing														
• Socket for SB-E bracket														
• Ring lite supports filters														
Controls														
• Back panel LCD, illuminated						•	•		•					
• Dot matrix LCD														
• Menu navigation														
• Coupling distance scale on LCD									•					
• Custom functions, CF settings											1, 2			4, 8
• Personal functions														
• Control dial														
• Control lock setting														
Power														
• Battery type	2CR5 lithium	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	External pack	4×AA	4×AA	2×AAA	4×AA	2×AA	2×AA
• High voltage port							•	•	•					
• Auto Power Off/Save Energy mode	15 sec	None	None	5 min	5 min	5 min	90 sec	None	90 sec	5 min	5 min	90 sec	90 sec	90 sec
• Power switch SE override				•					•					
• Custom function SE override									•					
Automatic metering														
• TTL (film only)	•	•		•	•	•	•	•	•	•		•		
• A-TTL (film only)				with T90 only	•	•	•		•					
• E-TTL and E-TTL II											•	•	•	•
• Autoflash Ext.A (auto)			•					•						
• Autoflash Ext.M (manual)														
	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II

For an enlarged PDF view of these tables, please visit the publisher's website at rockynook.com
Choose "Mastering Canon EOS Flash Photography" and then select "Look Inside/Add Ons."

	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT
	32	38	42	43	43	43	43	55	58	58	60	60	14	14	24		
	105	124	137	140	140	140	140	179	189	189	197	197	46	46	78		
				11	11	14	14		15	15	15	15					
								15									
	24	21	23	25	25	22	22	28	28	28	28	28					
		23	25	27	27	24	24	30	30	30	30	30					
		28	31	31	31	28	28	36	36	36	36	36					
	32	31	34	34	34	33	33	42	42	42	42	42					
		33	37	37	37	40	40	46	50	50	50	50					
				40	40	41	41	50	53	53	53	53					
		38	42	43	43	43	43	55	58	58	58	58					
											60	60					
	2011	1995	2000	2005	2008	2015	2015	1998	2004	2007	2012	2012	2000	2014	2001	1998	2012
	Current	2001	2005	2008	2015	Current	Current	2004	2007	2012	Current	Current	2014	Current	Current	Current	Current
	70×115×75	75×114×104	72×123×99	72×122×101	72×122×101	71×114×98	71×114×98	80×138×112	76×134×114	76×137×117	80×143×125	80×143×125	74×126×97	70×119×71	74×126×97	62×51×80	67×62×77
													113×126×26	130×112×25	235×90×49		
	275g	270g	300g	320g	320g	290g	295g	405g	375g	405g	425g	425g	430g	455g	585g	100g	110g
	Metal	Plastic	Plastic	Plastic	Metal	Metal	Metal	Plastic	Plastic	Metal	Metal	Metal	Plastic	Metal	Plastic	Plastic	Metal
	Quick release	Wheel, pin	Wheel, pin	Wheel, pin	Quick release	Quick release	Quick release	Wheel, pin	Wheel, pin	Quick release	Quick release	Quick release	Wheel, pin	Quick release	Wheel, pin	Slide lock, pin	Quick release
											•	•					
										•	•	•					
				•	•				•	•	•	•					
														•			
				•	•	•	•	•	•	•	•	•	•	•	•		•
						•	•				•	•		•			•
						Wheel	Wheel				Buttons	Buttons		Buttons			Buttons
								•	•	•	•	•					
	4, 8			6, 12	9, 20	10, 24	10, 24		14, 28	14	18, 42	18, 42	7, 14	12, 27	9		8, 19
						8, 15	8, 15				7, 14	7, 14		3, 4			3, 5
						•	•		•	•	•	•		•			•
						•	•				•	•		•			•
	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	4×AA	2CR5 lithium	2×AA
								•	•	•	•	•	•	•	•		
	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec	90 sec		5 min
								•					•		•		
		•							•	•	•	•		•			•
		•	•	•	•			•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
										•	•	•					
										•	•	•					
	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT

	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II
Manual flash output control														
• **Manual output controls on unit**				•		•	•	•	•					
• **Output controls on compatible camera**													•	•
• **Illuminated test button ("pilot")**				•	•	•	•	•	•	•		•		
• **Number of output levels**				2		6	6	3	8				19	19
• **Lowest output level**				1/16		1/32	1/32	1/16	1/128				1/64	1/64
• **Increments**													1/3 stop	1/3 stop
• **Feet/meters user-configurable**							No		Switch					
• **Optical slave capabilities**								Optional						
PC socket								•						
Tilt and swivel														
• **Tilt, up/down**	Fixed head	Fixed head	Fixed head	90°U	Fixed head	90°U	90°U	90°U	90°U, 7°D		Fixed head	Fixed head	90°U	90°U
• **Swivel, left/right**				180°L, 90°R		180°L, 90°R	180°L, 90°R	180°L, 105° R	180°L, 90°R				No swivel	No swivel
• **Single-button tilt/swivel release**														
Flash head coverage (for 35mm frame)														
• **Fixed flash head coverage**	35mm	35mm	35mm					35mm			24mm	28mm	28mm, 50mm	28mm, 50mm
• **Optional clip-on panels**		28mm	28mm					20, 135mm						
• **Hand-operated zoom head positions**				4									2	2
• **Motorized zoom head positions**					4	6	6		7					
• **Zoom head focal range**				24–85mm	28–70mm	24–80mm	24–80mm		24–105mm					
• **Zoom setting LEDs**				•	•									
• **Zoom setting on LCD**						•	•		•					
• **Manual control of motorized zoom**						•	•		•					
• **Sensor size compensation**														
• **Coverage adjustment**														
• **Pull-out wide panel; coverage**									18mm					
• **Pull-out catchlight card**														
• **Bounce/diffuser attachment**														
• **Color filter sensor**														
Autofocus assist														
• **Red LED; points covered**	1	1			1	1	1		5			1		
• **Red LED range, center**	1–5m	1–5m			0.9–6m	0.9–8m	0.9–10m		0.5–15m			0.7–5m		
• **Red LED range, periphery**														
• **White incandescent**							•			•				
• **White LED**														
• **Pulses flash (with compatible bodies)**											•		•	•
Flash exposure lock (FEL)				with T90 only							•	•	•	•
High speed sync/FP mode											•	•	•	•
High speed sync control											Camera menu	Button	Camera menu	Camera menu
Flash exposure bracketing (FEB)														
Flash exposure compensation							Buttons		Buttons					
FEC in 1/3 increments														
Second curtain sync														
• **SCS enabled by switch**				with T90 only	•									
• **SCS enabled by +/– buttons**						•	•		•					
• **SCS via camera CFn/menu**											•	•	•	•
Recycling														
• **Approx recycle time, alkaline AAs**	0.3–1.7 sec	0.3–1.7 sec		0.2–13 sec	0.3–8 sec	0.2–13 sec	0.2–13 sec	0.2–17 sec	0.2–13 sec	0.2–13 sec	0.1–5.5 sec	0.1–4.5 sec	0.1–3.9 sec	0.1–3.9 sec
• **Flashes per charge, alkaline AAs**	400–4000	400–4000		100–700	200–2000	100–700	100–700	100–700 (TP3)	100–700	100–1000	100	250–1700	100–680	100–680
• **Rapid fire/Quick Flash capability**	•			•	•	•	•		•				•	•
• **Rapid fire with high voltage port**									•					
• **Silent recycling**														
Stroboscopic flash rate						1–5 Hz	1–10 Hz		1–100 Hz					
Number of repeated flashes									1–100					
Flash exposure confirmation LED								•	•	•		•		
	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II

	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT
				•	•	•	•	•	•	•	•	•	•	•	•		
	•					•	•			•	•	•		•			
		•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	19	22	22	7	19	22	22	22	22	22	22	22	7	22	7		
	1/64	1/128	1/128	1/64	1/64	1/128	1/128	1/128	1/128	1/128	1/128	1/128	1/64	1/128	1/64		
	1/3 stop	1/3 stop	1/3 stop	1 stop	1/3 stop	1/3 stop	1/3 stop	1/3 stop	1/3 stop	1/3 stop	1/3 stop	1/3 stop		1/3 stop			
						C.Fn	C.Fn	Switch	Button	C.Fn	C.Fn	C.Fn		C.Fn			C.Fn
										•	•	•					
	90°U	90°U	90°U	90°U	90°U	90°U	90°U	90°U, 7°D	90°U, 7°D	90°U, 7°D	90°U, 7°D	90°U, 7°D					
	180°L, 90°R	No swivel	180°L, 90°R	180°L, 90°R	180°L, 90°R	150°L, 180°R	150°L, 180°R	180°L, 90°R	180°L, 180°R	180°L, 180°R	180°L, 180°R	180°L, 180°R					
				•	•	•	•		•	•	•	•					
	24mm, 50mm																
	2																
		6	6	7	7	7	7	7	7	7	10	10					
		24–105mm	24–105mm	24–105mm	24–105mm	24–105mm	24–105mm	24–105mm	24–105mm	24–105mm	20–200mm	20–200mm					
		•	•														
				•	•	•	•	•	•	•	•	•					
				•	•	•	•	•	•	•	•	•					
				•	•	•	•		•	•	•	•					
						•	•				•	•					
				14mm	14mm	14mm	14mm	17mm	14mm	14mm	14mm	14mm					
						•	•		•	•	•	•					
						•	•				•	•					
						•	•				•	•					
		1	7	9	9	1	1	45	9, 45	9, 45	1–65	1–65				45	
		0.7–10m	0.7–7m	0.7–7m	0.8–7m	0.7–8m	0.7–8m	0.6–10m	0.6–10m	0.6–10m	0.6–10m	0.6–10m				0.6–10m	
			0.7–5m	0.7–5m					0.6–5m	0.6–5m	0.6–5m	0.6–5m					
													•		•		
	•													•			
	•					•	•										
	•	•	•	•	•			•	•	•	•	•	•	•	•		
	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Camera menu	Switch	Switch	Button	Button	Menu	Menu	+/– buttons	Button	Button	Menu	Menu	+/– buttons	Menu	+/– buttons	Button	Menu
								•	•	•	•	•	•	•	•		
				Buttons	Buttons	Dial	Dial	Buttons	Dial	Dial	Dial	Dial	Buttons	Dial	Buttons		
				•	•	•	•	•	•	•	•	•	•	•	•		
				•	•			•	•	•			•		•		
	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
	0.1–2.3 sec	0.1–7.5 sec	0.1–7.5 sec	0.1–3.7 sec	0.1–3.7 sec	0.1–3.5 sec	0.1–3.5 sec	0.1–8 sec	0.1–6 sec	0.1–5 sec	0.1–5.5 sec	0.1–5.5 sec	0.1–7 sec	0.1–5.5 sec	0.1–7 sec		
	180–1000	260–1800	200–1400	200–1400	200–1400	180–1200	180–1200	100–700	100–700	100–700	100–700	100–700	120–800	100–700	120–800	1500	
	•					•	•	•	•	•	•	•		•			
								•	•	•	•	•		•			
					•	•	•			•	•	•		•			
								1–199 Hz	1–199 Hz	1–199 Hz	1–199 Hz	1–199 Hz					
								1–100	1–100	1–100	1–100	1–100					
		•	•	•	•			•	•	•			•	•	•	•	
	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT

	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II
Optical wireless E-TTL														
• Master capable, groups											•			
• Wireless feature enabled by:											Camera menu			Switch
• Slave capable, groups														A only
• Flash A/B ratio displayed on LCD														
• Flash A/B ratio LEDs														
• Visible light or infrared signals											Visible			
• Control signal range, center											8–10m			
• Control signal range, periphery											5–7m			
• Control signal angle											30–40°			
• Modeling flash													•	•
• Modeling flash in slave mode only														
Radio wireless E-TTL														
• Master capable, groups														
• Wireless feature enabled by:														
• Slave capable, groups														
• Auto channel scan														
• LINK LED														
• Linked shooting														
• Linked shooting socket for N3														
• Test flash														
• Remote camera release from slave														
• Memory function														
On-screen charge indicator														
Automatic WB compensation											•		•	•
Camera menu control (ESC)											•		•	•
RC-1-type camera remote control														•
White LED (for video etc)														
	160E	200E	200M	300TL	300EZ	420EZ	430EZ	480EG	540EZ	ML-3	90EX	220EX	270EX	270EX II

	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT
								A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	C	C	C	A, B	
	Switch		Switch	Switch	Button/Menu	Menu	Menu	Switch	Switch	Button/Menu	Button/Menu	Button/Menu	Switch	Button/Menu	Switch		
	A, B, C			A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C					
								•	•	•	•	•	•		•		
																•	
								Visible	Visible	Visible	Visible	Visible	Visible	Visible	Visible	Infrared	
								10–15m	10–15m	10–15m	10–15m	10–15m	3–5m	3–5m	5–8m	8–10m	
								8–12m	8–12m	8–12m	8–12m	8–12m					
								80° H, 60° V	80° H, 60° V	80° H, 60° V	80° H, 60° V	80° H, 60° V	80° H, 80° V	80° H, 60° V	50° H, 70° V	40° H, 30° V	
	•		•	•	•	•	•	•	•	•	•	•	•	•	•		
			•	•	•			•									
							A, B, C, D, E					A, B, C, D, E					A, B, C, D, E
							Button					Button					
							A, B, C, D, E					A, B, C, D, E					
							•					•					•
							•					•					•
							•					•					•
												•					•
							•					•					•
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							•					•		•			•
						•	•							•			
	•				•	•	•		•	•	•	•		•			
	•				•	•	•			•	•	•		•			•
	•																
	•																
	320EX	380EX	420EX	430EX	430EX II	430EX III	430EX III-RT	550EX	580EX	580EX II	600EX	600EX-RT	MR-14EX	MR-14EX II	MT-24EX	ST-E2	ST-E3-RT

	Medium	Year introduced	Maximum X-sync	TTL metering	TTL zones	A-TTL metering	E-TTL metering	E-TTL II metering	Evaluative Zones	Red AFassist	White AF assist	Pulse AF assist	Speedlite AF assist	Disable Internal	Disable Speedlite	Disable assist	Speedlite red/pulse	Built-in flash	Built-in flash GN	Flash coverage	Flash zooms	Flash auto raises	Flash auto lowers	Tall flash
EOS 620	35mm	1987	1/250	•	1	•			6															
EOS 650	35mm	1987	1/125	•	1	•			6															
EOS 750/750QD	35mm	1988	1/125	•	1	•			6	•			•					•	12	35mm		•	•	
EOS 850	35mm	1988	1/125	•	1	•			6				•											
EOS 1	35mm	1989	1/250	•	1	•			6				•											
EOS 600/630	35mm	1989	1/125	•	1	•			6				•											
EOS RT	35mm	1989	1/125	•	1	•			6				•											
EOS 10/10S/10QD	35mm	1990	1/125	•	3	•			8	•				•				•	12	28mm		•	•	
EOS 700	35mm	1990	1/125	•	1	•			6	•								•	12	35mm		•	•	
EOS 1000/Rebel	35mm	1990	1/90	•	1	•			3				•											
EOS 1000F/Rebel S	35mm	1990	1/90	•	1	•			3	•			•			•		•	13	17mm				
EOS 100/Elan/100QD	35mm	1991	1/125	•	1	•			6	•			•	•	•			•	12–17	28, 50, 80mm	•	•		
EF-M	35mm	1991	1/90						3															
EOS 1000N/Rebel II	35mm	1992	1/90	•	1	•			3				•	•		•			14	17mm				
EOS 1000FN/Rebel S II/1000S QD	35mm	1992	1/90	•	1	•			3	•			•			•		•	14	17mm				
EOS 5/A2/A2E/5QD	35mm	1992	1/60 – 1/200	•	3	•			16	•						•		•	13–17	28, 50, 80mm	•	•		
EOS 500/Rebel X/Rebel XS/Kiss	35mm	1993	1/90	•	3	•			6		•		•					•	12			•		
EOS 1N/1N HS/1N RS/1N DP	35mm	1994	1/250	•	3	•			16				•											
EOS 5000/888	35mm	1995	1/90	•	3	•			6		•		•					•	12					
EOS 50/Elan II/50E/Elan IIE/55	35mm	1995	1/125	•	3	•	•		6	•			•	•	•			•	13	28mm		•		
EOS 500N/Rebel G/New Kiss	35mm	1996	1/90	•	3	•			6		•		•					•	12			•		
EOS IX/IX E	APS	1996	1/200	•	3	•			5		•		•					•	11	22mm		•		
EOS IX 7/IX Lite/IX 50	APS	1998	1/125	•	3	•			6		•		•					•	10	22mm		•		
EOS 3	35mm	1998	1/200	•	3	•	•		21				•		•	•								
EOS 3000/88	35mm	1999	1/90	•	3	•			6		•		•			•		•	12					
EOS 300/Rebel 2000/Kiss III	35mm	1999	1/90	•	3	•	•		35			•	•			•		•	12	28mm		•		
EOS 1V	35mm	2000	1/250	•	3	•	•		21				•		•									
EOS 30/Elan 7E/33/Elan 7	35mm	2000	1/125	•	3	•	•		35			•	•	•	•	•		•	13	28mm		•		
EOS 3000N/Rebel XS N/66	35mm	2002	1/90	•	3	•	•		6		•		•			•		•	12	28mm				
EOS 300V/Rebel Ti/Kiss 5	35mm	2002	1/90	•	3	•	•		35			•	•			•		•	12	28mm		•		•
EOS 3000V/Rebel K2/Kiss Lite	35mm	2003	1/90	•	3	•	•		35			•	•			•		•	12	28mm		•		•
EOS 30V/Elan 7NE/33V/Elan 7N/7S	35mm	2004	1/125	•	3	•		•	35			•	•	•	•	•		•	13	28mm		•		
EOS 300X/Rebel T2/Kiss 7	35mm	2004	1/125					•	35			•	•	•		•		•	13	28mm		•		•
EOS DCS 1	DSLR	1995	1/250	•	3	•			16															
EOS DCS 3	DSLR	1995	1/250	•	3	•			16															
EOS D2000/Kodak DCS520	DSLR	1998	1/250				•		12				•											
EOS D6000/Kodak DCS560	DSLR	1998	1/250				•		12				•											
EOS D30	DSLR	2000	1/200	Doesn't fire			•		35		•		•	•	•			•	12			•		
EOS 1D	DSLR	2001	1/500	Full power			•		21				•		•									
EOS D60	DSLR	2002	1/200	Doesn't fire			•		35		•		•	•	•			•	12			•		
EOS 1Ds	DSLR	2002	1/250	Full power			•		21				•		•									
EOS 10D	DSLR	2003	1/200	Doesn't fire			•		35			•	•	•	•	•		•	13	18mm		•		
EOS 300D/Digital Rebel/Kiss Digital	DSLR	2003	1/200	Doesn't fire			•		35			•	•	•	•	•		•	13	28mm		•		•
Kodak DCS Pro SLR/c	DSLR	2004	1/180				•		8															
EOS 1D Mark II	DSLR	2004	1/250	Full power				•	21				•		•									
EOS 20D/20Da	DSLR	2004	1/250	Doesn't fire				•	35			•	•	•	•			•	13	17mm		•		•
EOS 1Ds Mark II	DSLR	2004	1/250	Full power				•	21				•		•									
EOS 350D/Digital Rebel XT/Kiss Digital N	DSLR	2005	1/200	Doesn't fire				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 1D Mark II N	DSLR	2005	1/250	Full power				•	21				•		•									
EOS 5D	DSLR	2005	1/200	Full power				•	35				•		•									

Popup flash manual	Popup flash stroboscopic	Redeye reduction	Optical Wireless	Radio Compat.	Radio Aware	Wireless ratios	Popup flash master	Internal FEC	External FEC	FEC in viewfinder	Flash micro adjustment	FEL controls	FEL icon	Modeling light	FEB	Zoom sensor	Auto fill	PC socket	Ignores PC polarity	250v trigger	Second curtain sync	SCS internal	SCS external	Weather-proofed	CPU type	ESC menu control	Ext.A autoflash	Color temp.	Auto ISO, bounce	Live View	Live View silent mode	LV, no ext. flash
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			•			•												•	•	•	•				Kodak							
		•	•	•		•		•	•			AE lock		•				•			•	•	•		Unnamed							
			•			•		•	•	•		Dedicated	•	•	•			•	•	•	•		•		DIGIC							
		•	•	•		•		•	•			AE lock		•				•			•	•	•		Unnamed							
			•			•			•	•		Dedicated	•	•	•			•	•	•	•		•		DIGIC							
		•	•	•		•		•	•			Assist button		•	•		•	•			•	•	•		DIGIC							
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			•			•		•										•			•				Kodak							
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		•	•	•		•		•				AE lock	•	•	•	•				•	•	•	•		DIGIC II			•				
			•	•		•		•	•	•		Dedicated	•	•	•	•		•	•	•	•		•	•	DIGIC II			•				
			•	•		•			•			AE lock		•	•		•	•	•	•	•		•		DIGIC II			•				

	Medium	Year introduced	Maximum X-sync	TTL metering	TTL zones	A-TTL metering	E-TTL metering	E-TTL II metering	Evaluative Zones	Red AF assist	White AF assist	Pulse AF assist	Speedlite AF assist	Disable Internal	Disable Speedlite	Disable assist	Speedlite red/pulse	Built-in flash	Built-in flash GN	Flash coverage	Flash zooms	Flash auto raises	Flash auto lowers	Tall flash
EOS 30D	DSLR	2006	1/250	Doesn't fire				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 400D/Digital Rebel XTi/Kiss Digital X	DSLR	2006	1/200	Doesn't fire				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 1D Mark III	DSLR	2007	1/300	Full power				•	63				•		•									
EOS 40D	DSLR	2007	1/250	Full power				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 1Ds Mark III	DSLR	2007	1/250	Full power				•	63				•		•									•
EOS 450D/Digital Rebel XSi/Kiss X2	DSLR	2008	1/200	Full power				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 1000D/Digital Rebel XS/Kiss F	DSLR	2008	1/200	Full power				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 50D	DSLR	2008	1/250	Full power				•	35			•	•	•	•			•	13	17mm		•		•
EOS 5D Mark II	DSLR	2008	1/200	Full power				•	35				•		•									
EOS 500D/Digital Rebel T1i/Kiss X3	DSLR	2009	1/200	Full power				•	35			•	•	•	•	•		•	13	17mm		•		•
EOS 7D	DSLR	2009	1/250	Full power				•	63			•	•	•	•	•	•	•	12	15mm		•		•
EOS 1D Mark IV	DSLR	2009	1/300	Full power				•	63				•		•									
EOS 550D/Rebel T2i/Kiss X4	DSLR	2010	1/200	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS 60D	DSLR	2010	1/250	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS 600D/Rebel T3i/Kiss X5	DSLR	2011	1/200	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS 1100D/Rebel T3/Kiss X50	DSLR	2011	1/200	Full power				•	63			•	•	•	•	•	•	•	9.2	17mm		•		•
EOS 5D Mark III	DSLR	2012	1/200	Full power				•	63				•		•	•								
EOS 1D X	DSLR	2012	1/250	Full power				•	252				•		•	•								
EOS 60Da	DSLR	2012	1/250	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS 650D/Rebel T4i/Kiss X6i	DSLR	2012	1/200	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS M	mirrorless	2012	1/200	Full power				•	315	•			•			•								
EOS 6D / 6D N	DSLR	2012	1/180	Full power				•	315				•		•	•						•		
EOS 1D C	DSLR	2012	1/250	Full power				•	252				•		•	•								
EOS 700D/Rebel T5i/Kiss X7i	DSLR	2013	1/200	Full power				•	63			•	•	•	•	•	•	•	13	17mm		•		•
EOS 100D/Rebel SL1/Kiss x7	DSLR	2013	1/200	Full power				•	63			•	•	•	•	•	•	•	9.4	18mm		•		•
EOS 70D W / 70D N	DSLR	2013	1/250	Full power				•	63			•	•	•	•	•	•	•	12	17mm		•		•
EOS M2 / M2 W	mirrorless	2013	1/200	Full power				•	315	•			•			•								
EOS 1200D/Rebel T5/Hi/Kiss X70	DSLR	2014	1/200	Full power				•	63			•	•	•	•	•	•	•	9	17mm		•		•
EOS 7D Mark II	DSLR	2014	1/250	Full power				•	315			•	•	•	•	•	•	•	11	15mm		•		•
EOS M3	mirrorless	2015	1/200	Full power				•	384	•			•			•		•	5	18mm				
EOS 750D/Rebel T6i/Kiss X8i	DSLR	2015	1/200	Full power				•	315			•	•	•	•	•	•	•	12	17mm		•		•
EOS 760D/Rebel T6s/8000D	DSLR	2015	1/200	Full power				•	315			•	•	•	•	•	•	•	12	17mm		•		•
EOS 5DS / 5DS R	DSLR	2015	1/200	Full power				•	252				•		•	•	•							
EOS M10	mirrorless	2015	1/200	No shoe				•	–	•						•		•	5	15mm				

	Popup flash manual	Popup flash stroboscopic	Redeye reduction	Optical Wireless	Radio Compat.	Radio Aware	Wireless ratios	Popup flash master	Internal FEC	External FEC	FEC in viewfinder	Flash micro adjustment	FEL controls	FEL icon	Modeling light	FEB	Zoom sensor	Auto fill	PC socket	Ignores PC polarity	250v trigger	Second curtain sync	SCS internal	SCS external	Weather-proofed	CPU type	ESC menu control	Ext.A autoflash	Color temp.	Auto ISO, bounce	Live View	Live View silent mode	LV, no ext. flash
			•	•	•		•		•	•			AE lock	•	•	•	•	•	•	•	•	•	•	•		DIGIC II			•				
			•	•	•		•		•				AE lock	•	•	•	•				•	•	•	•		DIGIC II			•				
				•	•		•		•	•	•		Dedicated	•	•	•	•		•	•	•	•		•	•	2 DIGIC III	•	•	•		•		
			•	•	•		•		•	•			AE lock	•	•	•	•	•	•	•	•	•	•	•		DIGIC III	•	•	•		•	•	
				•	•		•			•	•		Dedicated	•	•	•			•	•	•	•		•	•	2 DIGIC III	•	•	•		•		
			•	•	•		•		•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC III	•	•	•		•		
			•	•	•		•		•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC III	•	•	•		•		
			•	•	•		•		•	•			AE lock		•	•	•		•	•	•	•	•	•		DIGIC 4	•	•	•		•	•	
				•	•		•			•			AE lock		•	•			•	•	•	•		•	•	DIGIC 4	•	•	•		•	•	
			•	•	•		•		•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC 4	•	•	•	•	•		•
	•	•	•	•	•		•	•		•			M-Fn button		•	•	•		•	•	•	•	•	•	•	2 DIGIC 4	•	•	•	•	•	•	
				•	•		•		•	•	•	•	Dedicated	•	•	•	•		•	•	•	•		•	•	2 DIGIC 4	•	•	•		•	•	
			•	•	•		•		•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC 4	•	•	•	•	•		
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			•	•	•		•		•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC 4	•	•	•	•	•		
				•	•	•	•			•			M-Fn button	•	•	•			•	•	•	•		•	•	DIGIC 5+	•	•	•	•	•	•	
				•	•	•	•			•	•	•	M-Fn button	•	•				•	•	•	•		•	•	2 DIGIC 5+	•	•	•		•	•	
	•		•	•	•		•	•	•	•			AE lock	•	•	•	•				•	•	•	•		DIGIC 4	•	•	•	•	•	•	•
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				•	•	•	•			•			Button			•						•		•		DIGIC 5	•		•		•		
				•	•	•	•			•			M-Fn button	•	•	•						•		•	•	DIGIC 5+	•	•	•	•	•	•	
				•	•	•	•			•			M-Fn button	•	•	•						•		•	•	2 DIGIC 5+	•	•	•		•		
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				•	•	•	•			•			Button			•						•		•		DIGIC 5	•	•	•		•		
			•	•	•		•		•	•			AE lock	•	•												•	•	•	•	•		•
	•	•	•	•	•	•	•	•	•	•	•		M-Fn button	•	•	•	•		•	•	•	•	•	•	•	2 DIGIC 6	•	•	•	•	•	•	
				•	•	•	•		•	•			Dial			•						•	•	•		DIGIC 6	•		•		•		
			•	•	•	•	•	•	•	•			AE lock	•	•	•	•					•	•	•		DIGIC 6	•	•	•	•	•		•
			•	•	•	•	•	•	•	•			AE lock	•	•	•	•					•	•	•		DIGIC 6	•	•	•	•	•		•
				•	•	•	•			•			M-Fn button	•	•	•			•	•	•	•		•	•	2 DIGIC 6	•	•	•	•	•	•	
									•				Dial									•	•			DIGIC 6					•		

Key to Appendix C: Features Tables

Medium. Recording medium: 35mm film, APS film, digital SLR.

Model name. If multiple model names are listed, it's because the same camera is sold under different names in different regions. For example, the camera known as the 500D in Europe and most of Asia is sold under the name Digital Rebel T1i in Canada and the U.S., and under the name Kiss X3 Digital in Japan. There are rarely any major differences between variants.

Year introduced. The year in which the camera was released.

Maximum X-sync. The highest shutter speed at which normal (non high-speed sync) flash photography is possible. See 7.11.

TTL metering. Whether TTL (through the lens) flash metering is supported. TTL flash metering is a film-only feature, and is never supported on digital bodies. Some digital cameras will fire TTL or A-TTL flash units at full power, whereas other digital bodies will not fire them at all. See 7.2.

TTL zones. The number of metering zones used by TTL or A-TTL. See 7.9.3.

A-TTL metering. Advanced TTL, a film-only variant of TTL metering. See 7.3.

E-TTL metering. Evaluative TTL, a flash metering system used by later film and all digital EOS bodies. See 7.4.

E-TTL II metering. An improved version of E-TTL. See 7.5.

Evaluative zones. The number of metering zones employed by the camera's evaluative metering system. See 7.8.5.

Red AF assist. The camera has a built-in red LED to help autofocus perform in low light conditions. See 9.7.1.

White AF assist. The camera has a bright white lamp to help autofocus perform in low light conditions. See 9.7.4.

Pulse AF assist. The camera pulses its popup flash unit in order to help autofocus perform in low light conditions. See 9.7.5.

Speedlite AF assist. The camera is able to use a directly connected Speedlite's autofocus assist light. See 9.7.

Disable Internal. The camera can disable its internal AF assist. See 9.7.6.

Disable Speedlite. The camera can disable an external Speedlite's AF assist.

Disable assist. The camera can disable autofocus assist altogether.

Speedlite red/pulse. The camera can distinguish between Speedlites with red AF assist lights and those that pulse the main tube for AF assist.

Built-in flash. The camera has a built-in popup flash unit. See 8.1.

Built-in flash GN. The metric guide number of the internal flash. See 7.15.

Flash coverage. The coverage of the internal flash unit, equivalent to the focal length of a lens. In the case of cropped image sensors, the actual focal length supported is used. See 9.5.

Flash zooms. The internal flash unit has a motorized zooming head.

Flash auto raises. The internal flash unit can pop up automatically, if light levels are low and if the camera is in an icon mode which uses flash.

Flash auto lowers. The internal flash unit has a motorized system for lowering the flash unit (no need to push it down manually).

Tall flash. The internal flash unit is on a longer strut system to raise the flash head farther from the center of the lens, thus reducing redeye slightly.

Popup flash manual. The internal flash unit can have its output settings specified manually. See 9.16.

Popup flash stroboscopic. The internal flash unit can pulse stroboscopically. See 9.21 and 15.8.

Redeye reduction. The camera has some form of redeye reduction system, typically a brief, bright light to cause a person's pupils to contract. See 9.8.

Optical wireless. The camera can support Canon's optical wireless E-TTL flash metering system, which uses pulses of visible light or infrared energy to send signals. See 9.17 and 11.8.

Radio compatible. The camera predates the release of radio wireless. It's a digital camera which can use radio wireless E-TTL only in basic three-group mode. See 11.11.3.

Radio aware. A digital camera which was designed from the start to support radio, and thus supports all advanced radio features. See 11.11.3.

Wireless ratios. Support for A, B, and C wireless ratios. See 11.8.4.

Popup flash master. The camera's built-in flash unit can control remote wireless E-TTL slave units. No additional hardware is required. See 9.18.

Internal FEC. The camera has on-board controls for flash exposure compensation. See 9.9.

External FEC. The camera supports flash exposure compensation on an external Speedlite if FEC controls are built into the flash unit.

FEC in viewfinder. The camera displays FEC settings in the viewfinder.

Flash micro adjustment. The camera can bias normal flash exposure settings. See 9.9.1.

FEL controls. The camera has a means for flash exposure lock (e.g., a separate FEL button, or the function is tied to AE lock). See 9.10.

FEL icon. The camera displays FEL information in the viewfinder.

Modeling light. Support for simulated modeling lights with external Speedlite flash units. See 9.24.

FEB. Support for flash exposure bracketing. See 9.13.

Zoom adjust. A digital camera can instruct an external Speedlite that a subframe image sensor is in use and compensate accordingly. See 9.5.4.

Auto fill. The camera can disable auto fill flash reduction. See 9.12.

PC socket. The camera has a socket for external sync-only flash. See 11.4.

Ignores PC polarity. The camera doesn't care about the polarity of a PC connector (i.e., whether the tip is positive or negative).

250v trigger voltage. The camera's hotshoe, and PC socket if present, can withstand up to 250 volt flash trigger circuits. See 10.5.

Second curtain sync. The camera is capable of supporting second curtain sync with directly connected Speedlite flash units. See 7.13.

SCS internal. The camera has internal controls (a menu item or a custom function) for enabling or disabling second curtain sync.

SCS external. The camera supports or honors any second curtain sync controls on an external Speedlite.

Weatherproofed. The camera has some form of sealing (rubber gaskets and so on) to protect it against dust or inclement weather. See 9.34.

CPU type. The type of internal digital image processor used by the camera.

ESC menu control. The camera can control a compatible Speedlite via a menu system. Various flash unit settings can be adjusted. See 9.30.

Ext.A autoflash. The camera can send ISO and aperture data to a 580EX II flash unit if it's in autoflash mode. See 9.26.1.

Color temp. The camera can receive data from a compatible flash unit for minor color adjustments. See 9.35.

Auto ISO, bounce. The camera can tell if the Speedlite is in bounce mode and, if so, increases auto ISO settings to compensate. See 9.4.

Live View. The camera can display live video from the sensor chip directly on the camera's preview screen. See 9.36.

Live View silent mode. The camera can use electronic first curtain in Live View for quieter performance. Silent mode is not compatible with flash.

LV, no ext. flash. The camera cannot fire studio flash units (i.e., non-Speedlite sync-only flash units) when in Live View mode.

Appendix D: Custom and Personal Functions

Speedlite 430EX custom functions

1	Auto power off	on/off
2	Power-off in slave mode	60 min / 10 min
3	Automatic compensation for subframe digital cameras	on/off
4	AF-assist beam	on/off
5	Modeling flash	on/off
6	LCD when shutter release pressed halfway	maximum range / aperture

Speedlite 430EX II custom functions

0	Distance display	meters / feet
1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
7	Test firing	1/32 power/full power
8	AF-assist beam	on/off
9	Auto-zoom for subframe digital cameras	on/off
10	Slave unit auto power off	60 min / 10 min
11	Cancelation of slave's auto power off: can be canceled by master within	8 hours / 1 hour
14	LCD when shutter release pressed halfway	maximum range / aperture

Speedlite 430EX III/430EX III-RT custom functions

0	Distance display	meters/feet
1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
8	AF-assist beam	on/off
10	Slave unit auto power off	60 min/10 min
11	Slave auto power off can be canceled by master within:	8 hours/1 hour
13	Flash exposure compensation	+/– button and dial/dial only
21	Light distribution	standard/guide number priority/even coverage
22	LCD panel backlight	on for 12 sec/off/always on
23	AF assist LED blinking in slave mode	AF assist LED and rear LED/rear LED only

Speedlite 430EX III/430EX III-RT personal functions

1	LCD display contrast	5 contrast levels
2	LCD color, normal shooting	green/orange
3	LCD color, master mode	green/orange
4	LCD color, slave mode	orange/green
5	AF-assist beam	annoying flash pulses/red LED
6	Quick flash	on/off
7	Flash in linked shooting mode	flash doesn't fire/flash fires
8	Dial function when SEL/SET pressed	SEL/SET required/directly set by dial

Speedlite 580EX custom functions

1	Automatic cancellation of FEB after three frames	on/off
2	FEB sequence	normal – + / – normal +
3	Flash metering	E-TTL / E-TTL II / TTL-only
4	Slave unit auto power off	60 mins / 10 mins of inactivity
5	Cancelation of slave's auto power off: can be canceled by master within	1 hr / 8 hrs
6	Modeling flash	available / not available
7	Flash recycling when using high voltage port. Note that flash needs working internal batteries to run, even if it's connected to a battery pack.	Use both internal batteries and high voltage port / use high voltage port only
8	Quick flash with continuous shooting	on/off
9	Test firing	1/32/full output
10	Modeling flash with test button	disabled / enabled
11	Automatic compensation for subframe digital cameras	enabled / disabled
12	AF assist beam off	disabled / enabled
13	Flash exposure compensation	dial and button / dial only
14	Auto power off activation	on/off

Speedlite 580EX II custom functions

0	Distance display	meters / feet
1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
3	Automatic cancellation of flash exposure bracketing (FEB) after three frames	on/off
4	FEB sequence	normal – + / – normal +
5	Flash metering	E-TTL/E-TTL II/TTL-only / external metering auto / external metering manual
6	Quickflash with continuous shot	disabled / enabled
7	Test firing with autoflash	1/32 power / full power
8	AF assist beam	enabled / disabled

9	Automatic compensation for subframe digital cameras	enabled / disabled
10	Slave unit auto power off	60 min / 10 min
11	Cancelation of slave's auto power off: can be canceled by master within	8 hours / 1 hour
12	Flash recycling when using high voltage port. Note that flash needs working internal batteries to run, even if it's connected to a battery pack.	Use both internal batteries and high voltage port / use high voltage port only
13	Flash exposure compensation	dial and button / dial only

Speedlite 600EX/600EX-RT custom functions

0	Distance display	meters/feet
1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
3	FEB cancellation after three frames	on/off
4	FEB sequence	normal – + / – normal +
5	Flash metering	E-TTL or E-TTL II/TTL-only/Ext.A or external metering auto/ Ext.M or external metering manual
6	Quickflash with continuous shot	disabled/enabled
7	Test firing with autoflash	1/32 power/full power
8	AF assist beam	enabled/disabled
9	Zoom compensation for subframe cameras	enabled/disabled
10	Slave unit auto power off	60 min/10 min
11	Slave auto power off can be canceled by master within:	8 hours/1 hour
12	Flash recycling when using high voltage port	both internal batteries and high voltage port/high voltage port only
13	Flash exposure compensation	+/– button and dial/dial only
20	Beeper	off/on
21	Light distribution	standard/guide number priority/even coverage
22	LCD panel backlight	on for 12 sec/off/always on
23	AF assist LED blinking in slave mode	AF assist LED and rear LED/rear LED only

Speedlite 600EX/600EX-RT personal functions

1	LCD display contrast	5 contrast levels
2	LCD color, normal shooting	green/orange
3	LCD color, master mode	green/orange
4	LCD color, slave mode	orange/green
5	Color filter detection	Auto/off
6	Wireless button sequence	normal – radio – optical/normal – radio/normal – optical
7	Flash in linked shooting mode	flash doesn't fire/flash fires

Macro Ring Lite MR-14EX II custom functions

1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
3	FEB cancellation after three frames	on/off
4	FEB sequence	normal – + / – normal +
5	Flash metering	E-TTL or E-TTL II/TTL-only
6	Quickflash with continuous shot	disabled/enabled
7	Test firing with autoflash	1/32 power/full power
12	Flash recycling when using high voltage port	both internal batteries and high voltage port/high voltage port only
13	Flash exposure compensation	+/– button and dial/dial only
15	Wireless	slave group C only/slaves A, B, and C
18	Macro focus lamp	press LAMP button/double-tap shutter release halfway
22	LCD panel backlight	on for 12 sec/off/always on

Macro Ring Lite MR-14EX II personal functions

1	Focus lamp brightness	5 brightness levels
2	LCD display contrast	5 contrast levels
3	LCD color, master mode	green/orange

Speedlite Transmitter ST-E3-RT custom functions

1	Auto power off	on/off
2	Modeling flash	on: DOF button/on: test button/on: both buttons/off
3	FEB cancellation after three frames	on/off
4	FEB sequence	normal – + / – normal +
7	Test firing with autoflash	1/32 power/full power
13	Flash exposure compensation	+/– button and dial/dial only
20	Beeper	on/off
22	LCD panel backlight	on for 12 sec/off/always on

Speedlite Transmitter ST-E3-RT personal functions

1	LCD display contrast	5 contrast levels
3	LCD color, master mode	green/orange
4	LCD color, slave mode	orange/green

Appendix E: Sequence of Operation

E-TTL (film and digital) sequence of operation

The usual E-TTL sequence of operation, not counting the optional flash exposure lock (FE lock) feature or wireless operation, is as follows:

- When the shutter release is pressed halfway, the current ambient light levels are metered by the camera as usual. Shutter speed and aperture are set by the camera or user depending on the current mode: PIC (icon) modes or P, Av, Tv, or M.
- When the shutter release is pressed all the way, the flash unit immediately fires a low-power preflash from the main flash tube (i.e., white light).
- The reflected light from this preflash is analyzed by the same evaluative metering system that the camera uses for metering ambient light levels. The appropriate power output (i.e., flash duration) of the flash is determined by an internal computer which subtracts the ambient light level. The entire sensor area is evaluated and compared to the ambient metering, and the area around the active focus point is emphasized. The value of the required power output is stored in memory. If manual focus mode is used, then either the central focus point or averaged metering is used.
- If the photo is being taken under bright lighting conditions (10 EV or brighter), auto fill reduction is applied (unless it has been disabled by a custom function, as is possible on some bodies), and the flash output is decreased by anywhere from 0.5 to 2 stops. Canon has not published details of the E-TTL auto fill reduction algorithms, and they vary from model to model.
- The mirror flips up and the shutter opens, exposing the film or sensor chip.
- The flash tube is then fired at the previously determined power level to illuminate the scene. Start time of the flash burst depends on whether first or second curtain sync has been set. The OTF sensor in the camera, in the case of most EOS film cameras, is not used in E-TTL mode.
- The shutter stays open for the full duration of the shutter speed time.
- The shutter closes and the mirror flips back down. If the flash unit has a flash exposure confirmation light, and if the flash metering was deemed sufficient, the light glows.

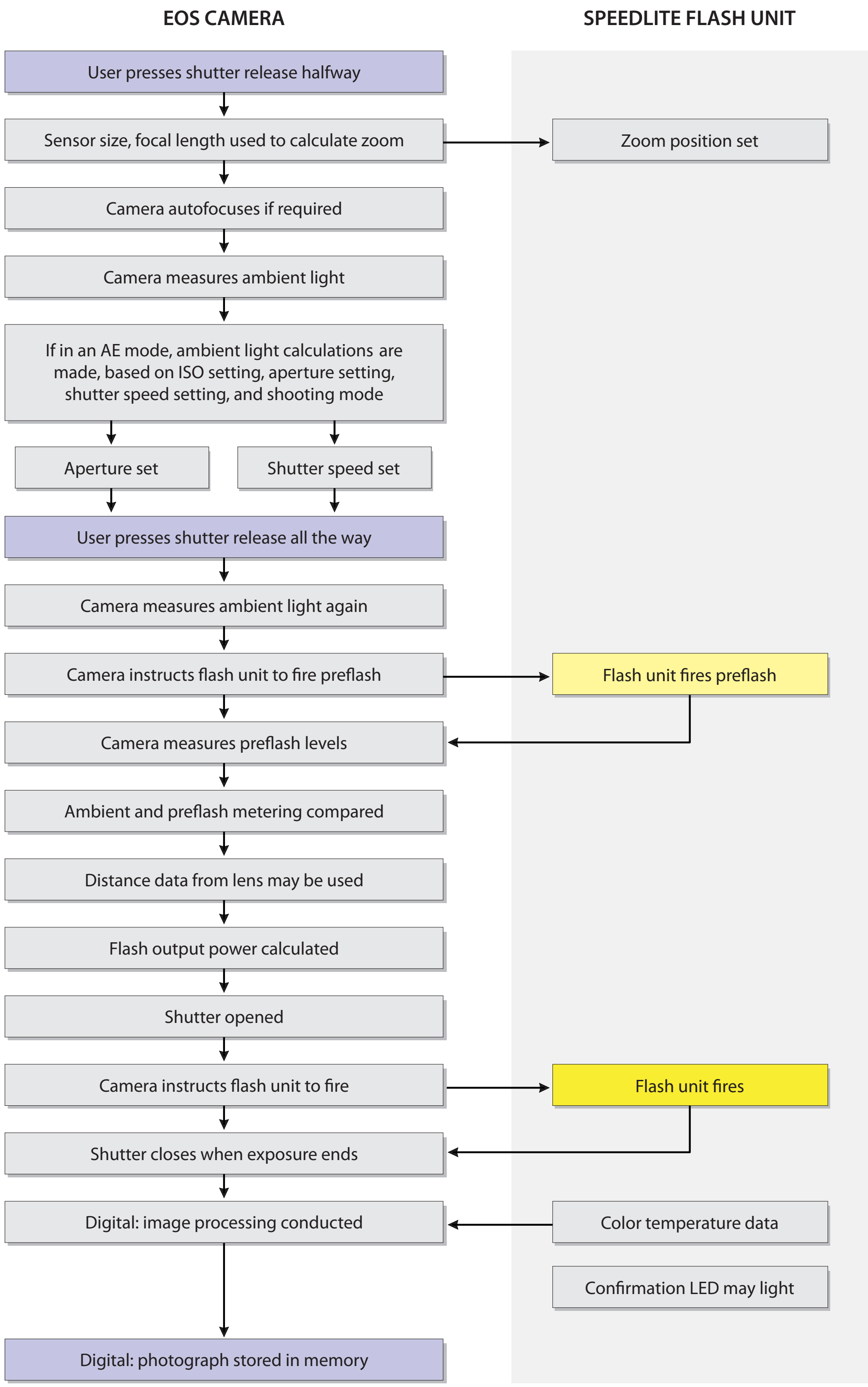

Table 17.1: Basic E-TTL II sequence, not including user-selectable options such as sync timing (first, second, high speed), metering types, and flash exposure compensation.

E-TTL II sequence of operation

E-TTL II is similar to E-TTL in terms of the basic sequence. The primary differences are as follows:

- Exposure is not biased to any focus point.
- Distance data from the lens is factored into the calculations if the flash unit is not in bounce mode or wireless.
- The user has the ability to specify whether evaluative or averaged metering is used for the ambient light.
- The camera actually performs ambient metering twice. The first reading occurs when the shutter release is half-pressed and is used for automatic exposure settings as normal. The second reading occurs when the button is pressed all the way and is used as a point of comparison for the preflash reading. ☐ Table 17.1

Wireless E-TTL sequence of operation

The wireless E-TTL control sequence is as follows:

- Photographer presses the shutter release button halfway.
- Ambient light metering of the scene is conducted.
- Photographer presses the shutter release all the way.
- The master flash unit sends a wireless signal—optical or radio is appropriate—to all slave units in group A, instructing them to issue a low-power preflash.
- Any slave units in group A fire a preflash, and the camera records this light output using its evaluative meter.
- The master flash instructs group B slaves to issue a preflash.
- Any slave units in group B fire a preflash, and the camera records this light output.
- The master flash instructs group C slaves to issue a preflash.
- Any slave units in group C fire a preflash, and the camera records this light output.
- In the case of radio wireless E-TTL, and if groups are enabled, the camera may instruct slave groups D and E to issue preflashes as well.
- The camera calculates what the final flash output for the scene should be, based on both the preflash data from each slave group (if any) and the user-defined group ratios/flash exposure compensation settings.
- The camera flips up the mirror and opens the shutter.
- The master flash instructs all slave units to fire simultaneously.
- All slave units fire at whatever level the master unit has told them to. If the master flash unit is flash-capable and is configured to fire, then it too will do so.
- The camera flips down the mirror and closes the shutter.

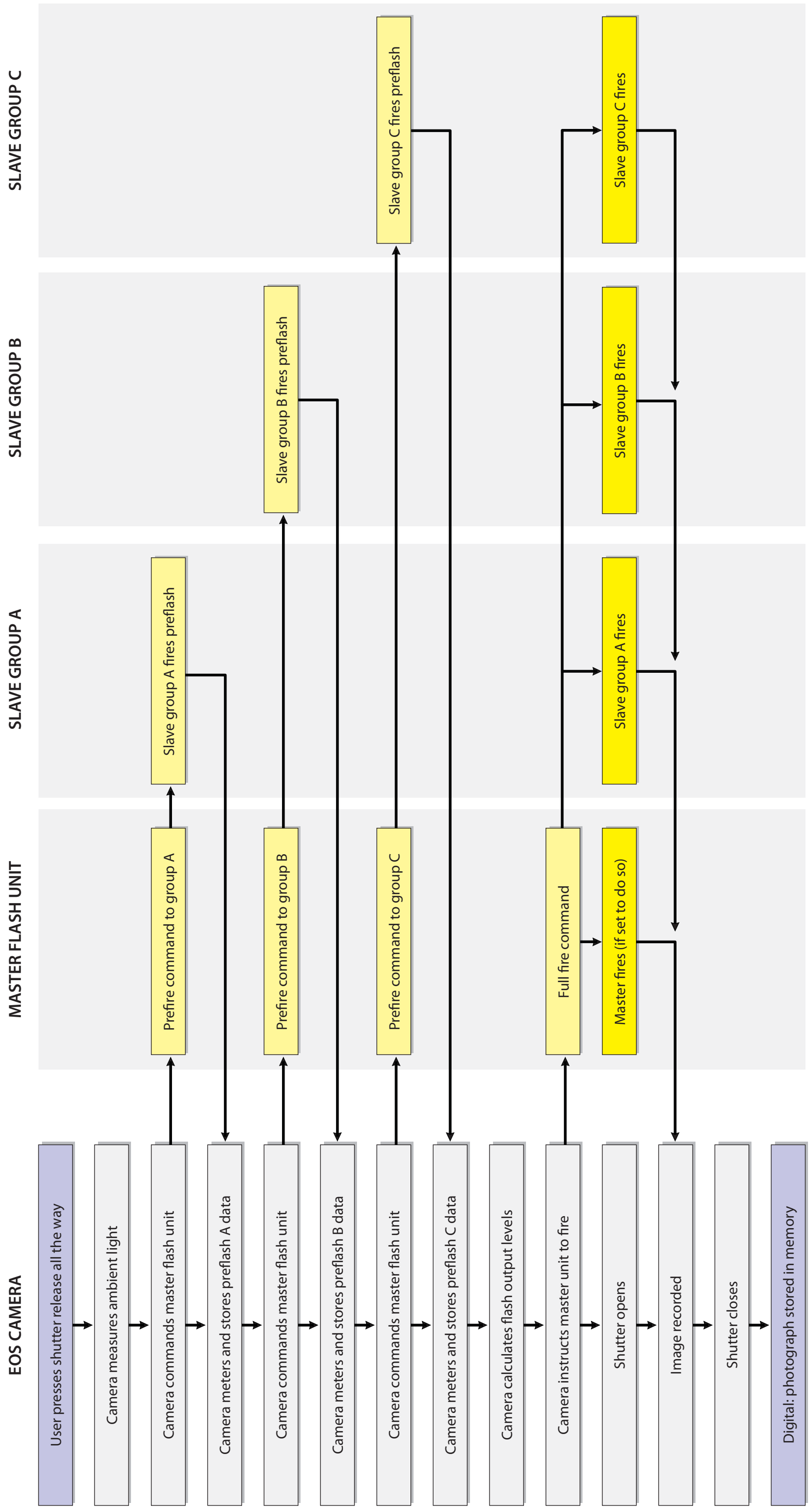

Table 17.2: Wireless E-TTL sequence with three slave groups in use.

There are, of course, differences in the timing of some of these events if AE lock or flash exposure lock (FE lock) are used, but this is the basic work flowchart. The command pulses and prefires occur at an extremely rapid rate. Optical wireless commands will register with a human observer but occur far too quickly to be interpreted as much more than a flash burst. They also occur prior to the shutter opening and so should not light the scene. Radio wireless commands are, of course, invisible.

TTL (film only) sequence of operation

- When the shutter release is pressed halfway, the ambient light levels are metered by the camera. Shutter speed and aperture are set depending on the current mode: P, Av, Tv, M, or icon mode. In P mode and most icon modes, the camera sets the shutter speed to between 1/60 and X-sync. In the other modes it meters normally (except cameras with a custom function that locks to X-sync in Av mode).
- When the shutter release is pressed fully, the mirror flips up and the shutter opens, exposing the film.
- If second curtain sync is used, the shutter stays open for nearly the full duration of the shutter speed time.
- The flash unit illuminates the scene. The start time depends on whether first or second curtain sync has been set. First curtain: immediately after the shutter opens. Second curtain: shortly before the shutter closes.
- Duration of the flash pulse is determined by the off-the-film (OTF) flash sensor. Under bright lighting conditions (10 EV or brighter), auto fill reduction is applied, unless disabled by a custom function. This reduces the output by 0.5 to 1.5 stops.
- When the foreground subject has been adequately lit (by real-time measurement of flash reflecting off the surface of the film), the flash tube is turned off. Light from the flash unit is quenched.
- The shutter remains open for the rest of the shutter speed time in the case of first curtain sync.
- The shutter closes and the mirror flips back down.
- If the flash unit has a flash exposure confirmation LED, and if flash metering was deemed adequate, then the light glows.

A-TTL (film only) sequence of operation

The A-TTL sequence of operation is as follows:

- When the shutter release is depressed halfway, the current ambient light levels are metered by the camera. In P and Tv modes, the ambient aperture value is determined and stored, but not set. In Av and M modes, the ambient aperture value is user-set.
- In order to determine the approximate distance from the flash to the main subject, the flash unit fires a preflash (either near-infrared light from a front-mounted secondary flash tube, or white light from the main flash tube, depending on the flash unit and operating mode) in conjunction with the ambient light metering. In P mode only, the correct aperture value to expose the main subject is then calculated.
- In P mode only, the two aperture values (ambient and flash) are compared when the shutter release is fully depressed. The camera typically sets the smaller of the two apertures, particularly if the distance to the subject is determined to be fairly close. In Av and M modes the aperture is determined by the user setting, and in Tv mode the aperture is determined by the ambient light meter settings.
- If the photo is being taken under bright lighting conditions (10 EV or brighter), auto fill reduction is applied, unless it has been disabled by a custom function. This can reduce the flash output by anywhere from 0.5 to 1.5 stops.
- The camera flips up the mirror and opens the shutter, exposing the film.
- The flash unit then sends out the actual scene-illuminating flash. The start time of the flash pulse depends on whether first or second curtain sync has been set. Duration of the flash pulse is determined by the standard OTF sensor, which is exactly the same as TTL flash.
- The shutter stays open for the full duration of the shutter speed time.
- The shutter closes and the mirror flips back down. If the flash unit has a flash exposure confirmation light, and if the flash metering was deemed adequate, then the light glows.

Appendix F: Troubleshooting

Built-in flash

Why does the screen on my camera say “BUSY” with the flash symbol? The built-in flash won’t fire.

There are two possible reasons for this. The word “BUSY” appears briefly while the built-in flash charges up, during which time it’s unavailable. Also, if a built-in flash is fired too many times, then it goes into shutdown mode to avoid overheating. The unit has to cool down before the BUSY indicator goes away. Section 7.22.1.

There’s a dark curved shadow at the bottom of my photos.

The lens or lens hood is blocking the built-in flash unit. Try a smaller lens, remove the hood, or best yet, avoid built-in flash. Section 8.1.1.

Speedlite power issues

My flash unit will not power on.

Are the batteries in the right orientation? The battery compartment has a small picture indicating the correct polarity for each cell. ☐ 2.2
Are all the batteries charged or fresh? One or more dead or low batteries will prevent the unit from working.
Are you turning the unit on using its power switch and not its wireless on/off switch? See 9.17.

My flash unit doesn’t fire when I take a photo.

Are the batteries fresh?
Has the flash unit recycled and the PILOT light turned red? ☐ 2.4
Are the contacts clean? Does the flash unit respond in any other way to camera commands, such as adjusting zoom settings when the zoom lens is adjusted?
Is the flash unit a 580EX II in “E” mode on its display? If so, set custom function 5 to 0 to disable autoflash. This problem occurs because the camera is an older model that does not report ISO data to the flash unit..Is the flash unit in TTL mode and used with a digital camera?
If the setup is using Canon’s radio wireless, are both master and slave units showing a green LINK light?

My flash unit has two off switches. What do they do?

One is the main power on/off switch. The other controls wireless mode, and the "off" position means wireless is not engaged. Section 9.17.

Why does my flash unit turn itself off after a minute or two?

The flash unit has an "auto power off" or "save energy / SE" mode designed to reduce battery drain. It can be reawakened by pressing the button marked PILOT on most flash units, or if the flash unit is on-camera, by half-pressing the shutter release. Many Speedlites have the ability to extend or turn off SE mode through use of a custom function. Section 6.25.

Flash won't fire when I have Live View turned on.

The camera probably has Silent Shooting turned on, which isn't compatible with flash. Turn it off. Also, some cameras can't fire non-Speedlite flash units when in Live View mode. Section 9.36.

My flash unit buzzes and doesn't operate reliably, even when off camera.

Try changing the batteries. Some older Speedlites function erratically when power is low.

Flash unit compatibility

Can I use my Speedlite flash unit with a non-Canon EOS camera?

Probably not in an automatic fashion. Virtually no non-EOS cameras have flash metering systems compatible with Canon EOS. You should be able to get the flash unit to fire at full power when the camera takes a photo. If the flash unit has manual controls, then you can use it as an all-manual device.

Why won't my old Speedlite E or EZ flash work with my digital EOS camera? (See appendix C.)

Speedlite E, EG, and EZ flash units don't work automatically with digital EOS cameras. They may be used in all-manual mode if that function is built into the flash unit, but not in any automatic fashion. This is because these flash units predate E-TTL flash metering, which is the technology used by digital EOS cameras. Section 7.2.2.

Some digital bodies will fire an older TTL unit at full power only, whereas other bodies won't fire them at all. See Appendix C.

Why won't my new Speedlite EX flash work with my EOS film camera?

Many newer Speedlite EX flash units are not compatible with TTL flash metering used by older EOS film cameras. You'll need to use an older model Speedlite, or one that still has TTL support such as the 600EX.

Why won't my non-Canon flash unit work with my Canon camera?

Some non-Canon flash units don't support Canon's metering technologies. Those that do may not support it properly, and thus may not be compatible with all Canon cameras. If the flash unit is a recent model, contact the manufacturer and see if there's a firmware update to fix the problem. If not, and if the flash unit lacks manual controls, then I'm afraid it's not worth keeping. Section 8.5.

Why does my camera say my flash unit is incompatible? It seems to work OK.

Most post-2007 EOS digital cameras can control the settings on later Speedlite flash units via a menu system. However, if an older flash unit is put onto one of these cameras, and the "flash control" menu is selected, this error message appears. This does not mean that the flash unit as a whole is incompatible with the camera, just that it's not compatible with menu control. Section 9.30.

My flash unit has no or few physical controls on the case. How can I change its settings?

EX-series flash units like this generally require a post-2007 EOS digital camera, which has the ability to control Speedlite flash unit settings via a camera-based menu system.

I connected my camera and flash with a generic PC cord, but it only fires at full power.

PC cords are simple two-conductor cables that carry synchronization signals (fire the flash now!) but do not carry any other information. This means that correct metering information can't be sent from a camera to a flash using a PC cord. Section 11.4.

If your camera and flash unit are otherwise capable of communicating with each other (e.g., an EOS camera and a Speedlite flash unit), then you'll need a different type of cord—see section 11.5.1. Alternatively the flash unit can be used in full manual mode (chapter 10).

My Speedlite EX flash unit doesn't work when I hook it up with Canon-branded flash extension cables.

The old-style Canon flash extension cables (which have round 6 pin connectors) support TTL metering only. They are not compatible with E-TTL in any form. Section 11.5.2.

When I use a wireless adapter, my Speedlite fires once and then stops working.

This means you're using a wireless accessory, probably an optical slave adapter, that isn't compatible with Canon Speedlites. The flash unit will need to be turned off and turned back on again before it will respond. The best option is to buy a compatible flash trigger. Section 11.7.6.

Using the flash unit

The aperture value is blinking in the viewfinder when flash is turned on.

The camera is in Tv mode and there isn't enough ambient light for the background to expose correctly. Either open the aperture wider, turn up the ISO, shoot in P mode, or just deal with an underexposed background. Section 6.11.

The shutter speed value is blinking in the viewfinder when flash is turned on.

The camera is in Av mode and there isn't enough ambient light for the background to expose correctly. Either use a slower shutter speed, turn up the ISO, shoot in P mode, or just deal with an underexposed background. Section 6.12.

My 580EX II/600EX/600EX-RT won't work properly and just displays "E", "EM", "Ext.A" or "Ext.M" on its LCD.

The unit is in autoflash mode, referred to by Canon as "external metering". Set custom function 5 to setting 0 to disable autoflash, or use the mode button on the 600EX/600EX-RT. Section 9.27.

Flash photos suddenly overexpose or the flash unit stops firing. The screen on the flash unit is displaying "TTL".

The flash unit's contacts are dirty or aren't contacting the camera's hotshoe properly. Try cleaning the contacts—gently, and without use of solvents or erasers, which can damage the equipment.

The lower section of a Speedlite-lit image is dark.

The subject may be too close to the flash unit. Try tilting the flash head to the 7° down position. If that doesn't work, try using the flash unit off-camera with a diffuser, or use a macro flash unit. See 9.4.

Another possibility, if the dark edge is along the long side of the picture, is that your camera's shutter speed is set higher than its maximum X-sync value. Section 7.12.

Why are the eyes of the people in my photos half-closed?

E-TTL flash fires a preflash for metering purposes. There's an imperceptible delay between the preflash and the subject-illuminating flash, and a longer delay if second curtain sync is used. Though brief, this delay can be long enough for people with sensitive eyes to be caught mid-blink. Try disabling second curtain sync, if it's on. If it's not on, use FEL to fire the preflash manually, then take the photo. Warn your subjects that the flash unit will be firing twice. Section 7.4.1.

Why is metering for my E-TTL flash photos always completely wrong?

Are you using the focus and recompose technique with an E-TTL camera? This will cause problems. Section 7.4.1.

Is there a bright or highly reflective object in the frame when using E-TTL? Is the focus point over something really light or really dark? Section 7.4.1.

Is the flash unit fully seated in the hotshoe? Does E-TTL appear in the flash unit's LCD if it has one?

Are you using an early digital EOS camera such as a D30, D60, or 10D? If so, try putting the lens into manual focus mode when using flash.

Is the flash unit in E or EM mode? If so, disable autoflash. Section 9.27.

I need to take a bunch of flash photos really quickly, but the flash unit takes ages to charge up between shots.

This is a fundamental limitation of powering a flash unit with a few tiny AA batteries. The answer is a high-voltage battery pack. These packs are a bit cumbersome and can only be attached to high-end flash units, but they reduce cycle time from a few seconds to a second or two. Also, larger flash units generally have a faster recycle time than small ones, except the tiny ones that run off lithium batteries. Section 12.13.

Flash unit features

Why does “CF” or “C.Fn” appear on my flash unit’s display?
One or more custom functions have been set to a position other than the default. You have to go through the settings one by one to see which one has been set, however. See section 9.29 and appendix D.

My flash unit suddenly went crazy, buzzing and flashing the main tube for a moment.

This is probably the modeling flash, engaged by pressing the depth of field preview button (the unmarked button to the side of the lens mount on the camera). If desired, the modeling flash feature can be disabled on some units via a custom function. Section 9.25.

The clear plastic lens over my flash unit’s tube is faintly yellow. Is that normal?

Some flash units have a slightly warm tint to the Fresnel lens covering the tube. This is to compensate slightly for the bluish color that flash tends to produce. However, an orange or brown patch at the center of the lens indicates that the flash unit has been overdriven at some point, and the heat has melted the plastic. Section 7.22.1.

Why can’t I select second curtain sync?

Can both the camera and flash unit support it? A few really old film cameras can’t use it. See Appendix C.
Is the camera in an icon mode? Section 6.7.
Is the feature engaged, either via the camera’s custom function or the flash unit’s controls? Section 9.15.
Is the flash unit in wireless master or slave mode? Section 9.17.
Is the flash unit in stroboscopic (MULTI) or high-speed sync mode?
Are you using the camera’s flash control menu to set a flash unit that can’t be controlled by the External Speedlite menu? Section 9.30.

Flash exposure lock (FEL) won’t work.

Is the flash unit in E-TTL mode?
Is the camera a type A film model or a digital EOS body? See 7.6.
Is the camera in a non-icon mode? See 6.9.
Is Live View off? See 9.34.

Modeling flash won't work.

Is the camera in icon mode? See 6.7.
Is Live View engaged? See 9.34.
Is the camera a type B film body or an EOS 300/Rebel 2000 camera, which does not support modeling flash? See 7.6.

High-speed sync keeps resetting.

Sigma flash units will not stay in high-speed sync mode if the camera's shutter speed drops below X-sync. If this occurs, then the feature must be turned back on again on the flash unit. Canon Speedlites don't do this and switch automatically between regular sync and high-speed sync as appropriate whenever the flash unit is in HSS-capable mode. See Appendix A.

What is the unlabeled light on my flash unit for?

The LED with no markings is usually a flash exposure confirmation light. This light illuminates to indicate that enough light was produced by the flash to expose the image adequately. It lights up for a few seconds after a picture is taken. See 9.22.

Autofocus assist

The autofocus assist light on my camera's flash unit isn't working.

Is your camera in AI Servo mode? AF assist will not work in this autofocus mode. See 9.7.1.
Do you have a camera with multiple focus points and a flash unit that can't cover all of those points? Try selecting the center focus point and see if the AF assist light goes on. See 9.7.2.
Do you have a custom function or menu option that disables the AF assist light?. See 9.7.1.
Does your flash have a very weak AF assist light (e.g., 160E, 200E), making it difficult to see?
Is the ambient light bright enough so the AF assist light won't fire?
Do you have a flash20 unit that has an AF assist light? See Appendix C.

Yargh! Why does my flash unit produce blinding lighting pulses with a scary electric buzz when I try to focus?

The flash unit, or camera if it's a built-in flash unit, is pulsing its main flash tube to help autofocus to work under low light conditions. This is an effective way to provide enough light to focus, but it's also pretty unpleasant for anyone in front of the lens.

This type of AF assist can be turned off. Less obtrusive forms of AF assist are also available. See 9.7.

Why don't the AF assist lights on my Speedlite cover all the autofocus points on my camera?

Some flash units don't have full coverage of all the autofocus points on all camera models. See 9.7.2.

Why doesn't AF assist work with my ultra-wide lens?

Speedlites with red AF assist lights typically cover up to 28mm. Wider than that, and only the central focus point is likely to be covered.

Why is the AF assist light on the front of my flash unit pulsing a bright red light every second?

This indicates that the flash unit is in wireless E-TTL slave mode, waiting to receive commands from a master flash unit. This blinking light can't be disabled, which can be annoying in low light conditions, so sometimes a piece of black gaffer tape is the best solution. This function can be useful for determining where light from the flash is likely to fall, and indicates whether a slave unit is actually going to fire because it's fully charged. See 9.7.1.

My Speedlite 90EX/270EX/270EX II doesn't seem to have an AF assist, but it lists it in the manual.

These units lack the red autofocus assist light built into most other Speedlites. Instead, they have the ability to pulse the main flash tube during the autofocus process to help achieve lock, but this feature is only available on EOS digital bodies that can control external Speedlite units. Earlier digital cameras with this capability may need a firmware update for this type of AF assist to work, or may be permanently incompatible. It may also be possible to enable the feature on a newer camera and then transfer the flash unit over to an older model. See 9.7.5.

Can I use my flash unit for autofocus assist without it firing a flash?

Maybe. Many camera and flash unit combinations support this functionality by custom functions. It depends on the specific combination of camera and flash unit. See Appendix C.

Flash head coverage

Why is the zoom position displaying – – mm?

This indicates that the flash head has been tilted or rotated when the flash zoom position was set to automatic. See 9.4 and 9.5.2.

Can I use my 135mm lens with a flash unit that only zooms to 105mm?

Yes. There's no problem using any long telephoto lens with the flash unit, it's just that the flash head can't narrow down its beam to match focal lengths longer than 105mm. This simply means that light that doesn't affect the image is being wasted, but it has no adverse effects. If a longer throw of the beam is needed, consider purchasing a flash extender. See 9.5 and 12.6.5.

The wide setting on my flash unit's zoom, 24mm, is blinking continuously on the LCD.

This means that the lens currently in use is wider than the widest coverage possible with the flash unit's zooming motor. Change the focal length or flip down the diffuser panel. See 9.6.

Can I use a 14mm lens with a flash unit that covers only up to 17mm?

You can, but the edges of the picture will not be properly illuminated.

Why can't I adjust flash zoom settings?

The diffuser is probably pulled out, or possibly broken. See 9.6.

Why is all the text on my flash unit's LCD blinking?

Canon flash units do this if the wide panel is extended when the flash head is in any position other than straight ahead.This is a warning that use of the wide panel in bounce mode is not recommended by Canon. See 9.6.

Why is the bounce icon on my flash unit's LCD blinking?

Some Canon flash units do this to indicate that the flash head is tilted downwards by 7°. See 9.4.

Wireless

Wireless slave flash units sometimes don't fire.

In the case of optical wireless E-TTL, can the slave units see the master unit (i.e., is there line of sight between the master unit's flash head and the slave unit's front-mounted receiver)? Are the two devices close enough? See 11.8.2.
Is the master unit set to "master" and the slave units set to "slave"?
Are the units all on the same channel? See 11.8.3.
Are all radio wireless devices set to the same device ID? See 11.8.3.

Are the LINK lights on radio wireless units lit green? See 2.5.
Are you waiting long enough for both master and slave units to recharge?

Can I set wireless slave Speedlites to manual mode?

Yes. You can either set the master unit to manual mode (section 11.8.5), or you can set each slave unit to manual mode. To do so, engage slave mode, then press and hold down the MODE button on the slave unit for a couple of seconds. See 11.8.5.

Why can't I use my Speedlite 430EX III or 430EX III-RT to command an optical wireless slave?

Neither the 430EX III nor the 430EX III-RT can be an optical wireless master. They can both be optical wireless slaves, and the 430EX III-RT can be a radio slave or master.

Why can't I use my camera in five group (Gr) radio wireless flash mode?

Only post-2012 cameras that are "radio-aware" have the necessary software to support five group radio wireless. Earlier models can only handle three group (A:B C) radio wireless. (see 11.11.3)

Why can't I use high-speed sync (HSS) when in radio wireless flash mode?

Only radio-aware cameras can use HSS over radio wireless. (see 11.11.3)

I have both optical wireless E-TTL slave units and radio wireless E-TTL. Can I use them together?

Not using the same wireless signalling, no. Optical and wireless E-TTL use completely different and incompatible systems. One transmits light signals and the other radio signals. However, the 600EX-RT and 430EX III-RT, can also be used as an optical wireless E-TTL slave unit in conjunction with an optical wireless E-TTL master.

Can I prevent a master flash unit from lighting the scene?

Yes. Speedlite flash units capable of wireless E-TTL master mode (with the exception of the macro flash units) are able to command remote slave Speedlites without themselves contributing any light to the scene. See 9.17.5. Sometimes onboard flash is useful as light fill, but often it's undesirable to have the master unit actually light things up.

Note that an optical wireless master unit will still issue pulses of light for control purposes, but these are produced before the shutter opens. Radio wireless master units do not do this.

Can I control optical wireless slave Speedlites using built-in flash?

That depends on the camera and flash unit you're using. Before the introduction of the EOS 7D in 2009, no EOS camera was capable of controlling a remote slave flash unit using optical wireless E-TTL without an add-on master flash unit. Many post-2009 EOS bodies with built-in flash will as well. See 9.18. Note that this applies to optical wireless E-TTL, and not to radio wireless E-TTL. No EOS camera currently has radio wireless E-TTL support built in.

Studio lighting

Why won't my Canon Speedlite flash unit trigger my studio flash gear properly?

If the flash unit is in E-TTL mode or optical wireless mode, and if the studio gear is using a "dumb" optical slave, then problems will arise. The preflash signals from the camera, used for E-TTL metering and for wireless control, will trigger the studio units' optical sensors prematurely. The studio units will fire, but their light will be mostly, or entirely, gone by the time the camera's shutter opens. See 11.7.3.

A Speedlite can only trigger studio flash if used in TTL mode (not recommended) or manual flash mode. The same applies to using built-in flash to trigger an optical slave, since most digital EOS bodies use automatic E-TTL preflash metering. A few post-2009 EOS bodies can avoid this problem, if they support manual control over the popup flash unit, since manual flash does not use a preflash.

Why won't second curtain sync work with my remote flash triggers?

On Canon EOS cameras, second curtain sync doesn't sync via the center pin. The sync command is handled by complex digital commands instead. Therefore, second curtain sync will not work with non-Speedlite flash units. See 9.15.2.

Why is there a dark underexposed rectangle down the side of my photos when I use studio flash?

The most likely explanation is that your camera has a shutter speed that's too high for the flash unit in question. This maximum speed is the camera's X-sync value. Also, if the flash unit is controlled by radio triggers, there could

be additional delays caused by the transmission. Try experimenting with slower shutter speeds on the camera. See 7.11.

A much less likely explanation—though one that might be the case if you see this problem when using an automated Speedlite-style flash, or if you see general exposure problems with all your photos—is that the shutter is failing.

Why does my camera manual specify two X-sync values?

Canon often specifies two maximum X-sync values: one for Speedlite external flash units, and a slightly lower one for studio flash units. This is because studio units often have a longer flash duration. There can also be delays in firing studio flash units as described above. See 7.11.1.

Can I use automatic and manual flash units simultaneously?

Quite often, yes. TTL/A-TTL metering with film cameras occurs after the shutter opens, and so manual flash would interfere with TTL metering. But E-TTL/E-TTL II metering occurs *before* the shutter opens. It's therefore possible to synchronize any number of manual flash units to fire at the same time as an automatic E-TTL unit. Naturally this will require careful adjustment of the manual slave or slaves to match the automated unit's output.

The manual slaves can be optical wireless E-TTL slaves with manual output controls (see 9.17.4) or simply ordinary flash units synchronized to a camera's PC socket. However, optical slave units cannot be used. See 11.7.3.

How can I shoot with wide apertures under studio lighting?

One drawback of studio lights is that they're often so bright that it isn't possible to shoot with a lens wide open to ensure narrow depth of field. It may be necessary to shoot at a low ISO setting such as 50, put darkening neutral density (ND) filters on the flash units, or an ND filter on the lens.

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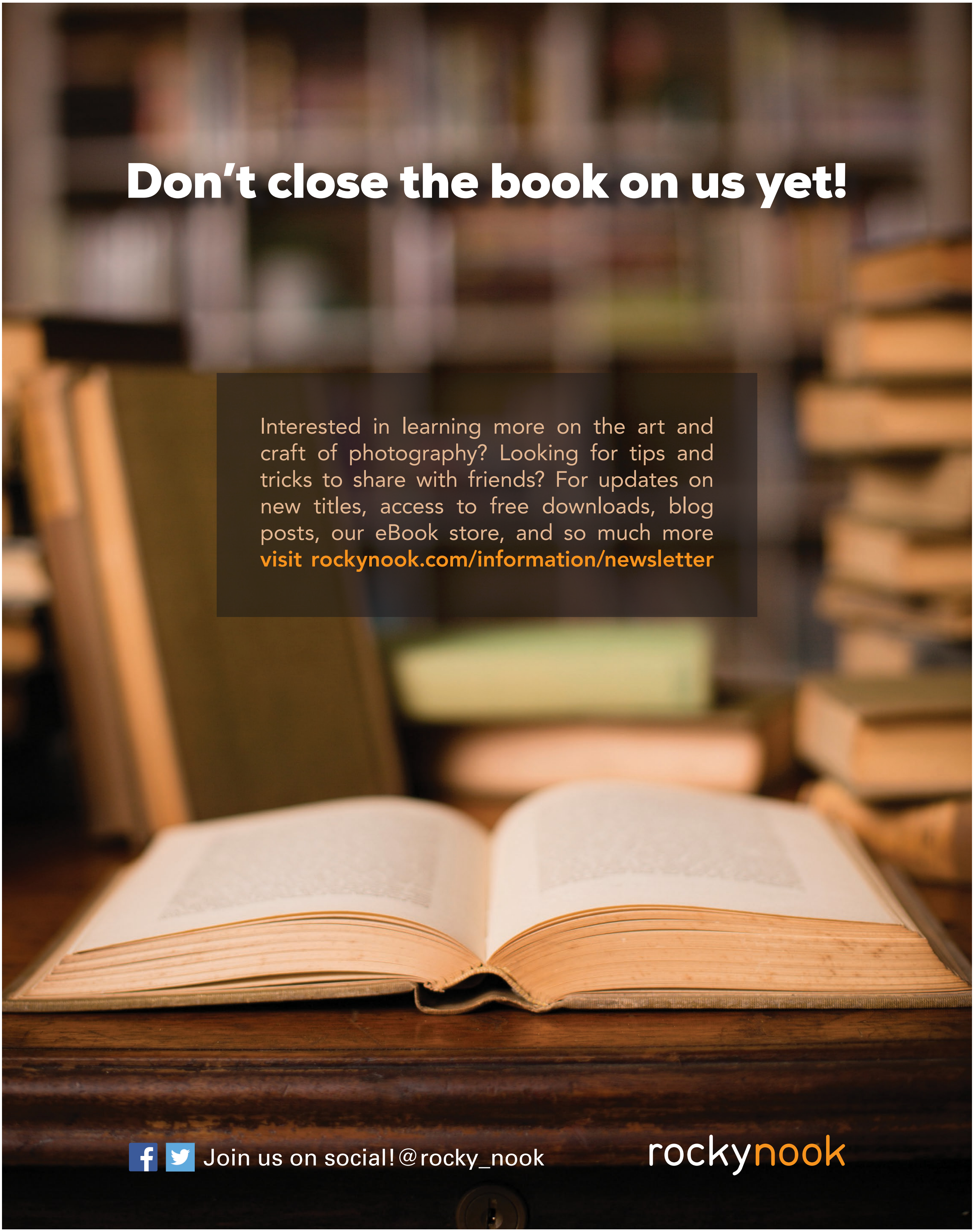
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